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SPECIFICATION

OF

WILLIAM GALLOWAY

AND

JOHN GALLOWAY.

STEAM ENGINES AND BOILERS.

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1854.



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W. & J. GALLOWAY'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, we, WILLIAM GALLOWAY and JOHN GALLOWAY, of Manchester, in the County of Lancaster, Engineers, send greeting.

WHEREAS Her present most Excellent Majesty Queen Victoria, by Her
5 Royal Letters Patent under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date at Westminster, the Eleventh day of March, One thousand eight hundred and fifty-one, in the fourteenth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto us, the said William Galloway and John Galloway, our exors, admors, and assigns,
10 Her especial licence, full power, sole privilege and authority, that we, the said William Galloway and John Galloway, our exors, admors, and assigns, or such others as we, the said William Galloway and John Galloway, our exors, admors, or assigns, should at any time agree with, and no others, from time to time and at all times during the term of years therein expressed,
15 should and lawfully might make, use, exercise, and vend, within England, Wales, and the Town of Berwick upon Tweed, and in the Islands of Jersey, Guernsey, Alderney, Sark, and Man, and also in all Her said Majesty's Colonies and Plantations abroad, our Invention of "IMPROVEMENTS IN STEAM ENGINES AND BOILERS;" in which said Letters Patent is contained a proviso
20 that we, the said William Galloway and John Galloway, shall cause a particular description of the nature of our said Invention, and in what manner the same is to be performed, by an instrument in writing under our hands

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and seals, or under the hand and seal of one of us, to be inrolled in Her said Majesty's High Court of Chancery within six calendar months next and immediately after the date of the said in part recited Letters Patent, as in and by the same, reference being thereunto had, will more fully and at large appear. 5

NOW KNOW YE, that in compliance with the said proviso, we, the said William Galloway and John Galloway, do hereby declare that the nature of our said Invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof, reference being had to the Drawings hereunto annexed, and to the figures and 10 letters marked thereon, that is to say :—

Our Invention relates, firstly, to the employment of various arrangements of water tubes in boilers, such tubes being made conical or larger in diameter at one end than at the other. Secondly, to a method of constructing fire flues of a triangular shape, stayed internally. Thirdly, to a method or methods of 15 constructing furnaces, furnace dampers, and fire feeding machines, so as to consume the smoke more effectually, either by their separate or joint use. Fourthly, to an arrangement for collecting and blowing off the sediment in boilers. Fifthly, to various improvements in the valves of engines and the mode of working the same, whereby the better entrance and exit of the steam 20 are obtained.

Sheet 1, Figure 1, of the Drawings hereunto annexed, is a longitudinal vertical section of one of our improved boilers; Figure 2 is a horizontal section of the same; Figure 3 is a transverse vertical section through the line *a, a*, in Figure 1; Figure 4 is a similar section through the line *b, b*, and 25 Figure 5 is a section through the line *c, c*, in Figure 1. The same letters refer to similar parts in each Figure. *A* is the shell of the boiler; *B, B'*, and *C, C'*, are the fire bars, contained in two oval or flat-sided furnace flues. The sides of these flues are stayed and prevented from collapsing by the bearers *D*, which support the fire bars. The two furnace flues unite in one throat *E*, 30 which narrows up a little, and then expands into the long fire flue *F*, which contains a number of conical water tubes *G, G, G*, formed with flanges at top and bottom, and rivetted to the top and bottom of the flue. It will be seen by the Figure 5 that the flue is made flat at top and bottom for the convenience of fixing the flanges of the tubes; the corners are rounded to render them 35 better adapted for resisting pressure. The tubes *G* are so placed as to divide and break up the flame, and a similar tube *H* is placed in the throat *E*. They are made of wrought iron plate bent up and rivetted or welded. These conical water tubes are formed with a flange at each end, and the difference

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in the diameters of the two ends is such that the flange at the lower end will pass through an aperture of the size of the tube at its upper end. By this means the tubes can be introduced through the holes in the top of the flue, and the top flange of the tube is thus above the flue and in the boiler, while
 5 the bottom flange is in the flue. A tube may thus be introduced without disturbing the other tubes. The taper form of the tube is advantageous as admitting of a more free escape for the steam than is the case with cylindrical tubes. When the conical water tubes are fixed otherwise than as above described, we make the diameter at the upper end larger than that at the
 10 lower end by at least three quarters of an inch for every foot in length of the tube. The tubes in the flue F may be all of the same size, or they may vary in size, and we prefer to use tubes of smaller diameter placed closer together at the end farthest from the furnace than those used at the end nearest to the furnace, as shewn in the Drawing. By water tubes we mean tubes containing
 15 water, in contradistinction to tubes which contain flame and are surrounded by water, which we call fire tubes, and which are commonly used in locomotive boilers.

The throat E is lined with fire-brick at the lower part, and the bridge I is also of fire-brick. Under the back set of fire bars B¹, C¹, in each furnace, is
 20 a pair of folding dampers J, J, which can be moved by rods K, K, so as to fold up to the under surface of the bars and check the ingress of air when required. By throwing coal alternately on each of the two fires, and regulating the ingress of air by the dampers J, the whole or the greater part of the smoke may be consumed.

25 Sheet 2.—Figure 6, is an end view; Figure 7 a transverse section, and Figure 8 a longitudinal section of a boiler with conical water tubes, in which the furnaces are external to the boiler, and the flame, after passing under the boiler, returns through it by an oval or flattened flue containing the conical water tubes; Figure 9 is a plan of the same, with the top of the shell
 30 removed. The tubes may be all of the same size, or smaller at one end of the flue than at the other, and we prefer to use smaller tubes placed nearer together at that end of the flue which in following the course of the flame is farthest from the furnace, and which, in this boiler, is over the furnace. The fire bars B, C, which are here shewn in a single length, are provided with folding
 35 dampers J, J, which check the passage of air through the back part of the bars, and which are moved by means of the levers J¹ and rods K. L are the fire doors, and M the brick setting. The two furnaces B and C are divided by a fire-brick wall. N is a cylindrical vessel placed beneath the boiler, with which it is connected by the conical water tube H and the tube O. This

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vessel serves as a sediment collector to receive the sediment deposited by the water in the boiler. The water is caused to circulate through the sediment collector by introducing the feed water through the pipe P into the tube O, which is protected from the direct action of the flame by a shield of brickwork. The tube H being exposed to the flame is thus kept hotter than the tube O, 5 and the water circulates in the direction of the arrows. Q is an agitator, capable of being turned on its axis by the handle R. S is a cock, connected with the sediment collector by a pipe. When it is wished to blow off the sediment, the agitator Q is set in motion and the cock S is opened, and a sufficient quantity of water is allowed to blow out to carry with it the 10 sediment.

Another form of boiler with conical water tubes is shewn in Figures 10, 11, 12, 13, and 14. Figure 10 is a side view with half of the shell removed. Figure 11 is a plan with the upper half of the shell removed. Figure 12 is a front view with the end of the shell removed. Figure 13 is a section through 15 the line *d, d*, in Figure 10 and 11; and Figure 14 is a section through the line *e, e*, in the same Figures. In this boiler two furnaces are employed, as in that shewn in Sheet 1. The flames unite in the throat E, in which are three vertical conical tubes H, and it then divides into the two cylindrical flues F, each of which contains a series of conical water tubes G, placed diagonally and 20 inclined alternately in opposite directions. By this means a large heating surface is obtained. The bridges T, T, at the back of the fires, are made of fire-brick, and have one, two, or more projecting pieces of fire-brick on the top, which serve to divide and break up the flames.

Sheet 3.—Figures 15, 16, and 17, shew another form of boiler with conical 25 water tubes of a form more particularly adapted for a marine boiler. Figure 15 is a view of a pair of such boilers placed side by side, and working into the same funnel U, one boiler being shewn in elevation and the other in section. Figure 16 shews a sectional plan of the furnaces of one boiler, and a plan of the upper tube plate and tubes of the other boiler. Figure 17 is a vertical 30 longitudinal section of one of the boilers. A is the shell; B, B, B, are the furnaces; D, D, the bearers for the fire bars, which also stay the sides of the furnaces; T the bridges; V the up-take; F the tube chamber; G, G, G, the conical water tubes; W the smoke box and flue leading to the funnel U. X, X, X, the doors of the smoke box giving access to the tubes. Y is a door 35 under the bridge, for removing ashes and dirt from behind the bridge. By thus arranging conical water tubes in a series of rows in a return flue, a large amount of heating surface is obtained in a small space, and advantageously disposed for the generation of steam.

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Figures 18, 19, and 20, represent a pair of boilers of a stronger form, and adapted for generating high-pressure steam for marine or other purposes. Figure 18 is a transverse section. Figure 19 is a sectional plan, shewing the furnaces B, B, of one boiler, and the upper tube plate forming the top of a
 5 flue or tube chamber F, which is flat at top and bottom and curved at the sides for the purpose of resisting the pressure. Figure 20 is a longitudinal section of one of the boilers. A is the shell; B, B, the cylindrical furnace flues with their fire bars; D, D, are the bearers; T the bridges; V the up-take; F the tube chamber; G, G, the conical water tubes; W, the smoke box and
 10 flue leading into the funnel U; Z is a steam chamber, into which the steam is admitted from the boilers by the pipes Z¹. Small pipes from the lower part of this chamber convey back into the boilers any water which may be carried over with the steam.

Sheet 4.—Figures 21, 22, and 23, show another form of boiler suitable for
 15 marine or other purposes. Figure 21 is a transverse section. Figure 22 is a longitudinal section; and Figure 23 is a sectional plan. A is the shell; B, C, the furnaces; F, the flue or tube chamber; G, G, the conical water tubes, arranged in a series of parallel rows in the tube chambers; V is the up-take, leading to the funnel. The flames from both furnaces unite and pass into the
 20 tube chamber F, where the heat is taken up by the conical water tubes, and the products of combustion then pass up the up-take V to the funnel. By this arrangement a large extent of heating surface is advantageously disposed in a boiler of small height.

Sheet 4.—Figures 24, 25, and 26, shew another of our improved boilers
 25 adapted for marine or other purposes, in which the principal part of the heating surface consists of fire flues in lieu of water tubes. Figure 24 is a transverse section; 25, a longitudinal section. Figure 26 is a horizontal section of a pair of such boilers, the section of the one boiler being taken through the furnaces, and that of the other through the flues and tubes. A is
 30 the shell of the boiler; B, C, the furnaces; T, the bridge; G, G, a few conical water tubes beyond the bridge; V, a passage or down-take, by which the flame from both furnaces descends and enters a series of fire flues F, F, of a triangular or wedge form of section, being broad at the bottom and narrow at the top. The flame thus returns under one furnace, and passing through the
 35 flue or box V¹ enters a series of fire tubes F¹, by which it is conveyed under the other furnace to the smoke box W and thence to the funnel U. The triangular flues F̄ are prevented from collapsing by the pressure of the steam by means of internal stays f, f, rivetted or otherwise fixed in the interior of the

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flue. By this arrangement a strong flue is obtained and one which is of an advantageous form for facilitating the ascent of the steam as it is formed.

In Sheet 5 is shewn a boiler with two furnaces, which are fed with fuel by means of a revolving plate, on the principle of the machine known as "Stanley's feeder." This arrangement, however, differs from the ordinary Stanley's feeder in certain parts, whereby it is adapted to feed the two furnaces in lieu of one. Figure 27 is a front view of the whole apparatus, with part of the hopper A removed. Figure 28 is a side view of the same, partly in section. Figure 29 is a plan, with part of the hopper removed; and Figure 30 is a sectional plan. A is the hopper; B, B, two pairs of toothed or grooved rollers, for drawing in and crushing the coal; C, C, are two other pairs of slightly indented rollers, which serve to distribute or deliver the coal on to the plate P, which revolves with rapidity and scatters the coal over the fire. K is a vertical shaft, driven by any first mover, and carrying an endless screw at its lower end, which drives a wheel L on the axis of one of the rollers C, which carries the pinions G, G, which drives the wheels H, H, on the axis of one of the rollers B. On the shaft K is a pulley N, which carries two straps, one open and the other crossed, which drive two pair of fast and loose pulleys O on the shaft F, which carries the plate P. By shifting the straps up and down the motion of the shaft F can be reversed at pleasure, while the rollers B and C continue to revolve in the same direction. D, D, are two slides, which are moved by the lever E, and allow the coal to fall between either pair of the rollers B, B, at pleasure. In using this apparatus one of the slides D is opened and the plate P is made to revolve in such a direction as to drive the coal which falls upon it over the fire V. After a time the slide D is closed and D¹ opened by moving the handle E, and the motion of the plate P is reversed by shifting the straps. The coal will then be scattered over the fire V¹. The action of the revolving plate is assisted by two vanes or blades, one of which is seen at Q in Figures 28 and 30. This blade turns upon a centre at q, and rests against the stop r. When the motion is reversed it bears against the stop s, and is thus always in a suitable position for striking the coal. By these arrangements the one feeder is made to supply both furnaces with fuel. Our improvements in steam engines relate to the valves and passages by which the steam enters and escapes from the cylinder.

Sheet 6.—Figures 31, 32, 33, and 34, shew a steam engine cylinder with one of our improved arrangements of valves adapted to it. Figure 31 is a vertical section through the steam passages and valve boxes. Figure 32 is a vertical section through the cylinder and the centre of the slide boxes.

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Figure 33 is a horizontal section of the same; and Figure 34 is an enlarged view of the face of the slide. B is the cylinder; C, the piston; D, the passage to the top of the cylinder, spreading out into the two ports A, A; D¹ is the passage to the bottom of the cylinder, spreading into the two ports A¹, A¹;
 5 E, E¹, are the slide valves, of the D form, and packed at the back with hemp or other packing F, F¹; G is the slide rod, by which both slides are moved. This rod receives its motion from an excentric or cam in the ordinary manner. It passes through a stuffing box at J. I, H, I, are three pillars cast hollow. The central one H is connected to the steam pipe K and serves to conduct the
 10 steam to both ends of the cylinder. The two external columns I, I, serve as the exhaust passages to convey the steam from the top of the cylinder to the exhaust pipe L. M is the throttle valve, placed between the pipe K and the column H. The pipe K may be cast in one piece with the cylinder, or it may be separate if preferred. The section, Figure 32, shews the piston C as
 15 having just commenced its up stroke and the valve E¹ is descending and opening the steam port. The edge of the valve being "vandyked" or formed with two or more V shaped notches, as shewn at *a*, *a*, *a*, in Figure 4, the consequence is that the steam is admitted gradually, which causes the engine to turn the centre easily at each end of its stroke. The valve descends
 20 sufficiently to open the upper port A¹, while the lower one remains closed. When the piston has completed its stroke the steam port will be closed, and the valve D¹ in rising will open both the ports A¹, A¹, by the spaces *b* and *c*, Figure 34, coming opposite to them. The upper valve E is of a similar form, but inverted, so that the vandyked edge may still be on the steam side of the
 25 valve. By this arrangement of valve a gradual opening and closing of the steam ports and a rapid opening and closing of the eduction ports is effected, and a free passage for the exhaust steam from the top of the cylinder is afforded by both columns I, I, being devoted to that purpose. The position of the throttle valve M gives it complete control over the engine, from the
 30 quantity of steam contained between it and the slide valves being comparatively small.

Figures 35, 36, 37, and 38, shew another of our improved arrangements of valves and valve gear. Figure 35 is a vertical section through the valve boxes and hollow columns H, I. Figure 36 is a vertical section through the column I
 35 and part of the cylinder B, and Figure 37 is a similar section through the column I. Figure 38 is a sectional plan. In this arrangement, four plain slide valves are used, two of which serve for steam, and two for the exhaust. Steam is admitted into the column H by a pipe connected to it at any convenient part, and enters the valve boxes M, M¹, and presses upon the upper

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surfaces of the valves E, E¹, as shewn in Figure 7. The valve E slides upon a face in which is an aperture or port through which the steam passes when the valve is opened and enters the top of the cylinder through the passage C. In a similar manner the valve E¹ admits the steam through the passage C¹ into the bottom of the cylinder. I is the exhaust pipe, connected to the con- 5 denser, or opening into the atmosphere by the pipe L, Figure 6. The valve F slides upon a face in which is a port, which, when open, allows the steam from the top of the cylinder to escape by the passage D, column I, and pipe L. In a similar manner the valve F¹ allows the steam to escape from the bottom of the cylinder through the passage D¹ and pipe L. The exhaust valves F, F¹, 10 may be plain rectangular valves, as shewn in the Drawings, or they may be grid-iron valves, that is to say, valves with one or more apertures through them, and working upon faces, with two or more ports, so that a small motion of the valve may give a large area of opening, as in the first arrangement of valves herein-before described. The steam valves E, E¹, may also be plain valves, 15 but we prefer to make the edge which admits the steam of an angular form, as shewn in Figure 38, or of a vandyked form, as shewn in Figure 34. S, S¹, T, T¹, are four openings for obtaining access to the valves. They are closed by covers or bonnets when the engine is at work. The four valves E, E¹, F, F¹, are worked by means of four cams or excentrics N, N¹, O, O¹, on the shaft P, 20 whose axis is parallel with that of the cylinder, and which is driven by a pair of bevil wheels Q, R. These excentrics work in rectangular frames fixed on the slide rods, and thus give motion to the slides. Or the excentrics may be surrounded by straps jointed to the slide rods in the ordinary manner. Or in place of excentrics cams may be employed, of such forms as to open and 25 close the valves at the proper times, and in such cases the ends of the slide rods may be kept in contact with the cams, so as to follow their motion either by counter cams or by springs or weights. In this manner the valves and cams may be arranged so as to give any required amount of expansion by cutting off the steam at any required position of the piston, and the whole 30 arrangement is compact in form and easily accessible.

Sheet 7.—Figures 39, 40, and 41, shew another improved arrangement of slide valve. Figure 39 is an elevation of the cylinder with a section of the valve. Figure 40 is an elevation of the cylinder and the back of the valve, and Figure 41 is a horizontal section of the cylinder and valve. A, B, is the valve, of a square or diamond form, working on the angular faces C, C¹. There 35 is no valve box, but the valve is kept in contact with the face by means of the two straps D, D¹. The valve is divided longitudinally into two compartments, one of which A is constantly filled with steam by means of the steam pipe K,

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while the other B is always in connection with the condenser by means of the pipe L. E is an aperture of the valve by which the steam enters the compartment A, and by which it is admitted to the top of the cylinder through the passage S when the valve is raised. The upper edge of the aperture is of an angular or vandyked form, so as to admit and shut off the steam gradually. E¹ is a similar aperture for admitting steam to the bottom of the cylinder when the valve is lowered. F is another aperture, which allows the steam from the top of the cylinder to escape into the compartment B, and thence through the larger aperture F¹ to the condenser or into the atmosphere. This last aperture F¹ serves for the escape of the steam from the bottom of the cylinder when the valve is raised. It is always open to the pipe L, which leads to the condenser. O is a rod from an excentric or cam, which works the valve through the intervention of the bent lever P and the link Q. R is a balance weight to balance the weight of the valve. If we now suppose the piston to be at the top of its stroke and the valve to be ascending, the aperture E will begin to admit steam to the top of the cylinder. The piston will then descend, and the steam below it will pass through the aperture F¹ to the condenser. The valve, having reached the end of its stroke, will return, and in doing so, will shut off the steam from the top of the cylinder. The steam which is in the cylinder will then expand and complete the stroke; when the piston has reached the bottom of the cylinder the valve will have descended sufficiently for the aperture E¹ to commence admitting steam to the bottom of the cylinder, and the aperture F will then be open to the top of the cylinder, allowing the steam therein to pass off to the condenser. In applying this valve to a condensing engine, the areas of the apertures E, E¹, F, F¹, may be so proportioned to the pressure of steam employed that the tendency of the pressure of the steam to force the valve off the face may be counteracted by the pressure of the atmosphere on the back of the slide brought into action by the apertures F, F¹, being in connection with the condenser. In this way the valve may be made to work with but little friction, and the straps D, D¹, will not be required to be pressed up tightly to the back of the valve. In some cases, however, where the pressure of the steam is not so counteracted, it may be found advantageous to press up these straps by means of springs or weights, or with the intervention of an elastic packing, so as to keep the valve in contact with the face. In such cases also the friction may be diminished, by subsisting rollers or wheels pressing against the back of the valve in place of the straps D, D¹.

Sheet 7.—Figure 42 is a section of a slide valve and part of a cylinder, showing an improvement in the application of the throttle valve. This improvement consists in placing a throttle valve M between the cylinder W and the slide valve or main valve of the engine E, by which means the throttle valve is

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brought so close to the cylinder as to have a more immediate effect upon the motion of the piston than when it is placed in the steam pipe in the ordinary manner. The ordinary throttle valve is capable of shutting off the supply of steam, but does not interfere with the passage of the steam to the condenser; but the throttle valve, arranged as here described, prevents both the ingress 5 and egress of the steam.

In Figure 43 is shewn a throttle valve M, placed between the main valve E and the cylinder W, but so arranged as only to close the entrance of the steam, without preventing its exit by the lower port when the valve E ascends. The steam is admitted through the upper port only by the descent of the valve E. 10

Having now described the nature of our Invention, and in what manner the same is to be performed, we wish it to be understood that what we claim is,—

Firstly, the constructing boilers with flues or chambers containing conical water tubes, whose taper or diminution of diameter from the upper to the lower end is not less than three quarters of an inch for each foot in length of 15 the tube, such tubes being open at both ends to the water spaces of the boiler, as herein-before described.

Secondly, the constructing boilers with flues or chambers containing conical water tubes with flanges at their ends, and of such form that the flange of the lower end may pass through the hole which receives the upper end of the tube, 20 as herein-before described.

Thirdly, the constructing boilers with flues or chambers containing conical water tubes with flanges at their ends, so placed, that the one flange is within, and the other without the flue or chamber, as herein-before described.

Fourthly, the constructing boilers with flues or chambers containing a series 25 of conical water tubes, whose diameters and distances apart diminish as they approach the chimney, as herein-before described.

Fifthly, the constructing boilers with flues or chambers containing conical water tubes, open to the boiler at both ends, and placed in a diagonal position, such conical water tubes being made with flanges, and fixed with one flange 30 within and the other without the flue, as herein-before described.

Sixthly, the constructing boilers with a series of rows of conical water tubes open to the boiler at both ends, and contained in one or more return flues or chambers, either over, under, or alongside of the furnaces.

Seventhly, the constructing boilers with a series of conical water tubes, open 35 to the boiler at both ends, and furnished with flanges, by which they are fixed in a flue or chamber, whose top and bottom are made flat for the reception of the flanges of the tubes, as herein-before described.

Eighthly, the constructing boilers with fire flues of a triangular or wedge form, stayed internally, as herein-before described. 40

FIG. 1.

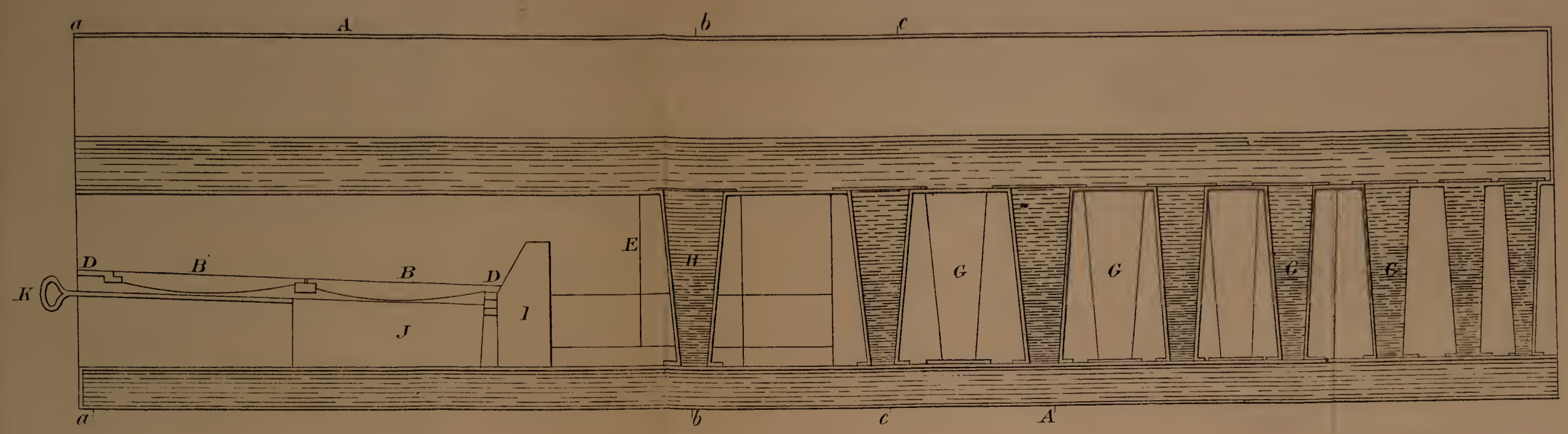


FIG. 2.

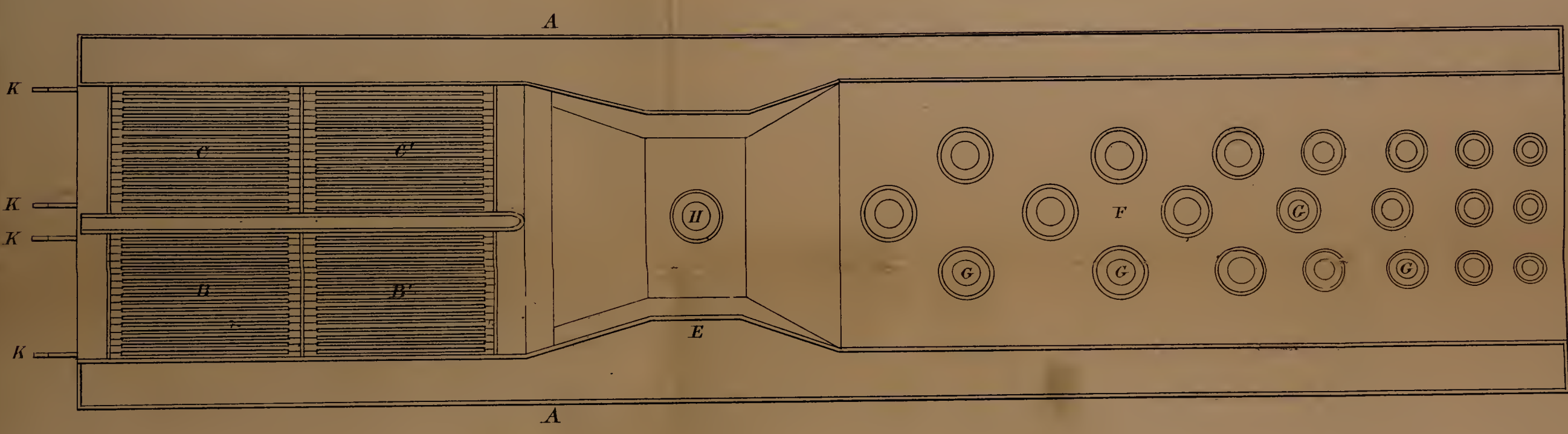


FIG. 3.

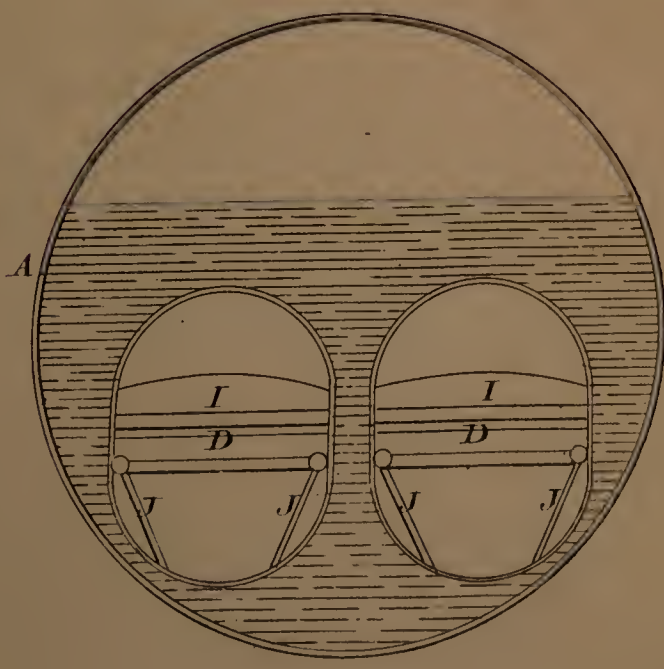


FIG. 4.

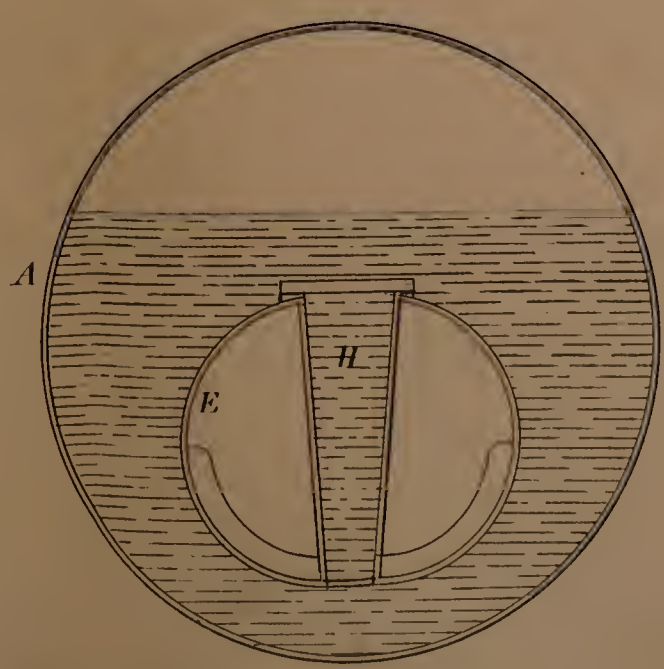


FIG. 5.

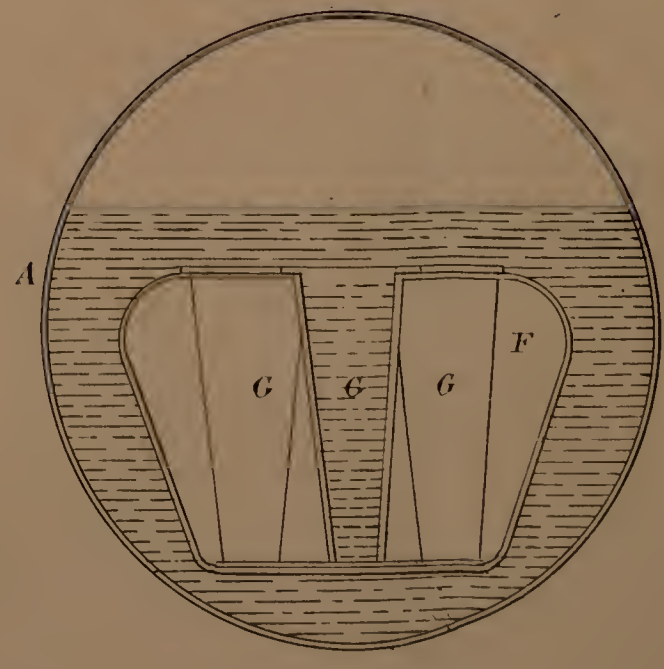


FIG. 7.

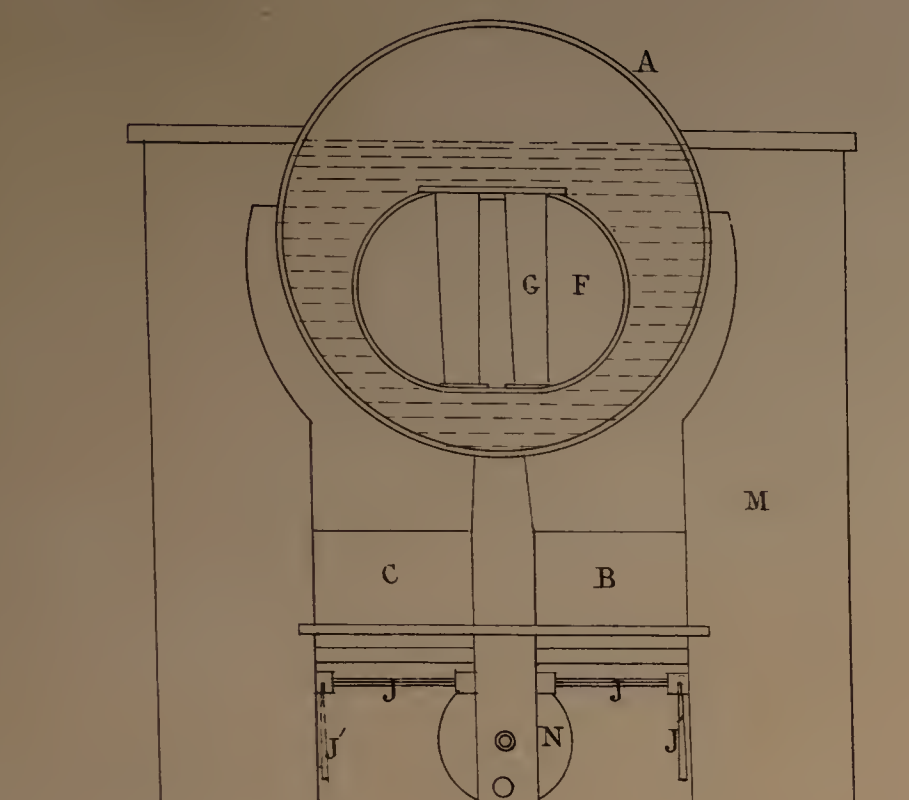


FIG. 8.

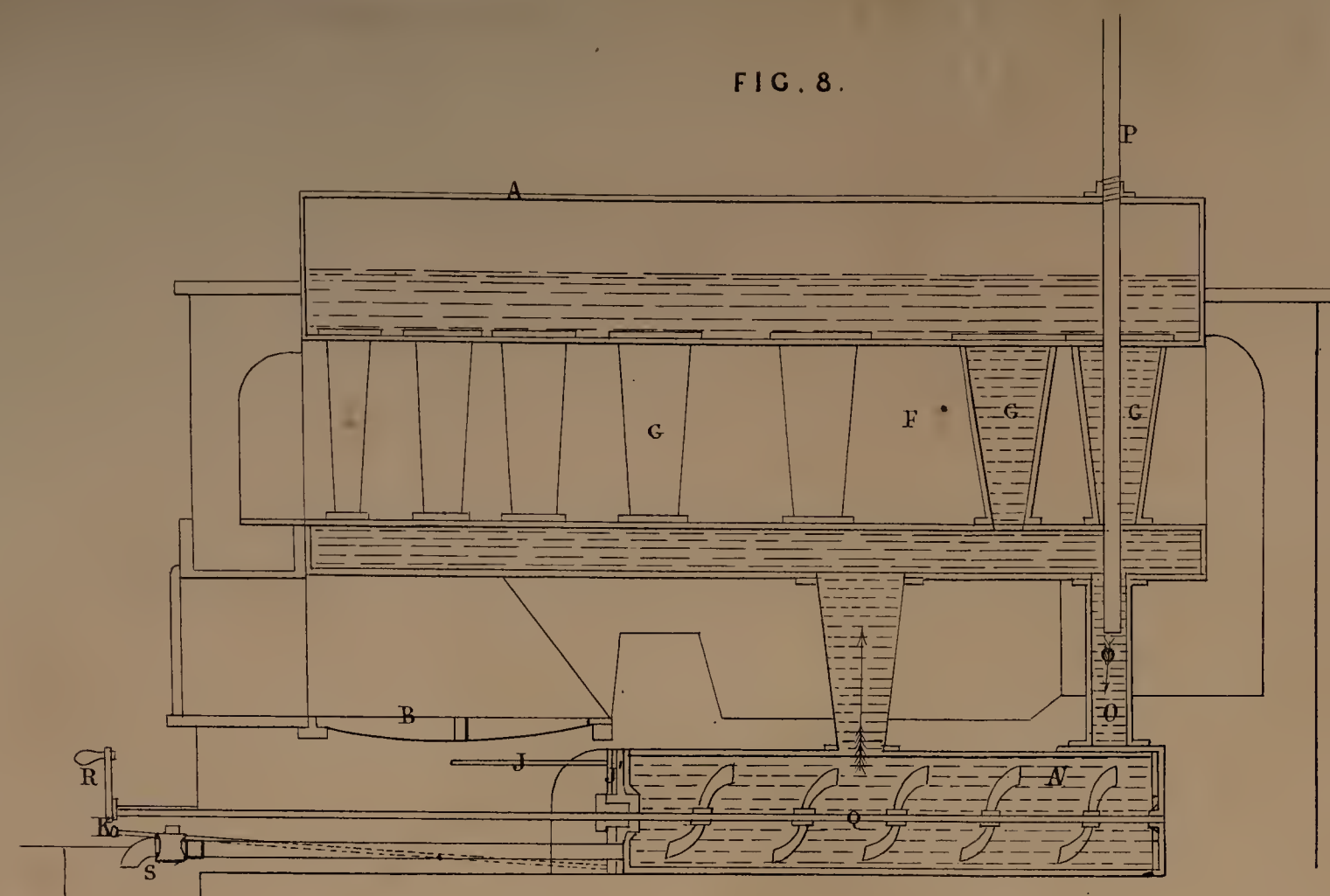


FIG. 9.

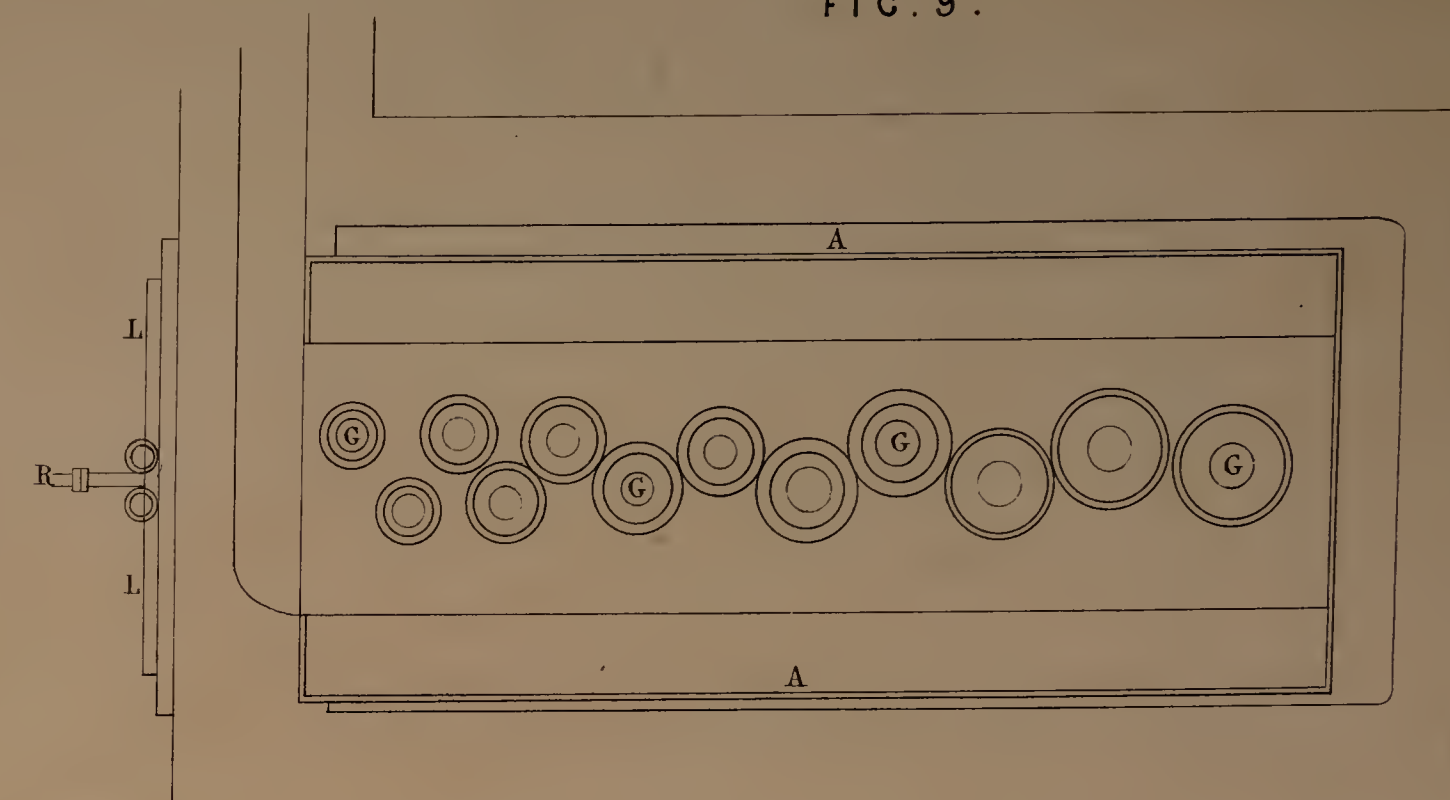


FIG. 12.

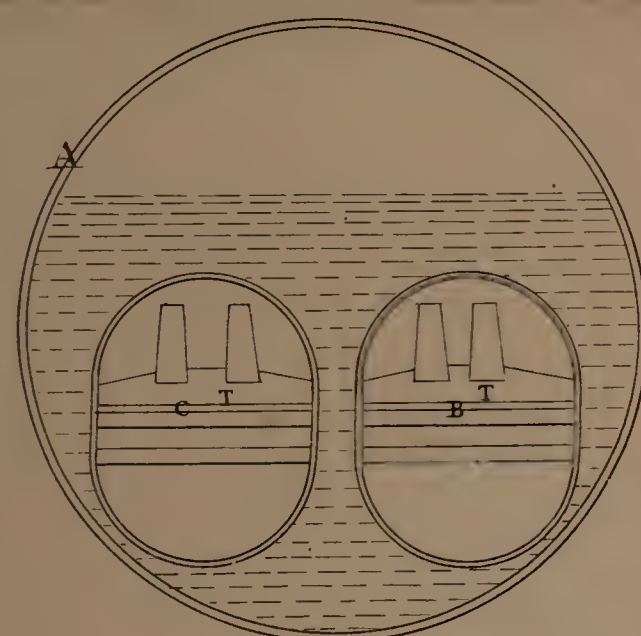


FIG. 10.

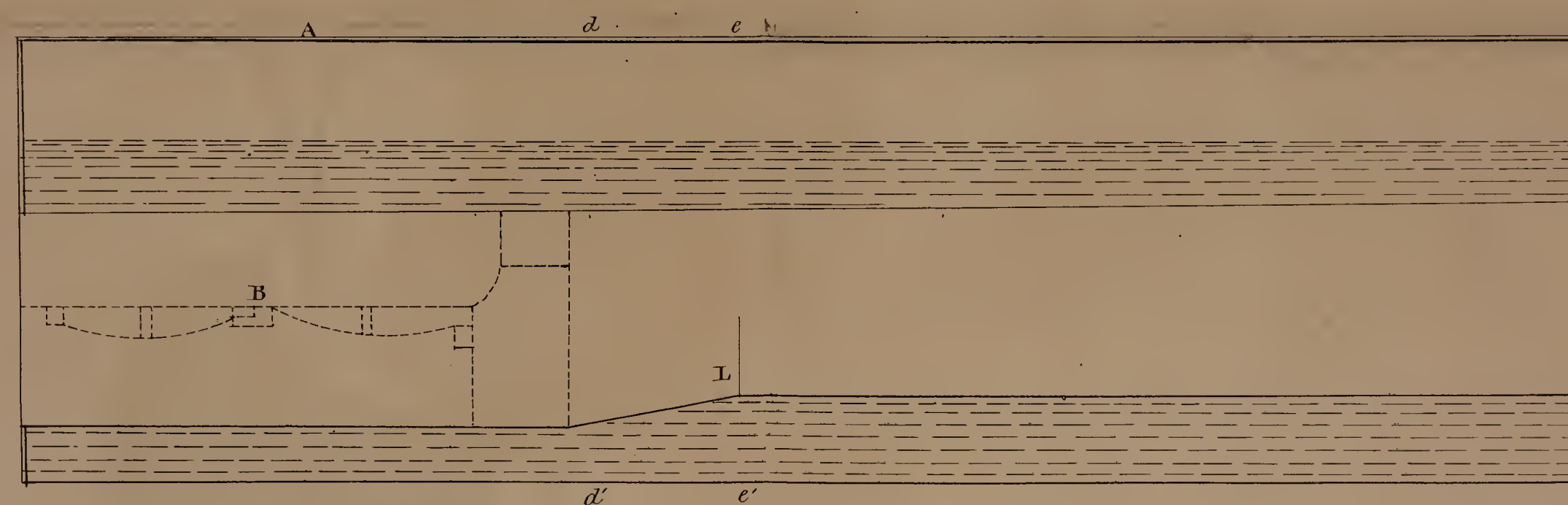


FIG. 6.

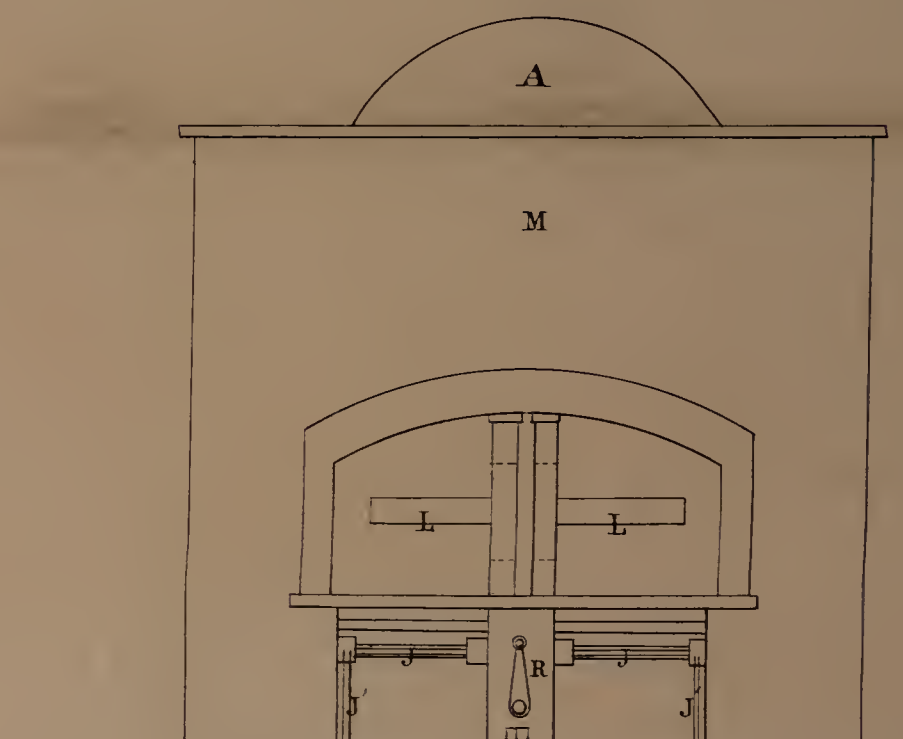


FIG. 14.

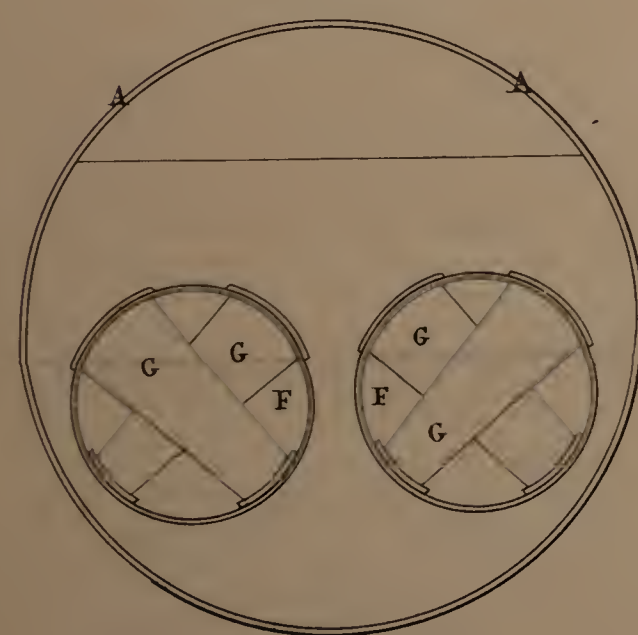


FIG. 11.

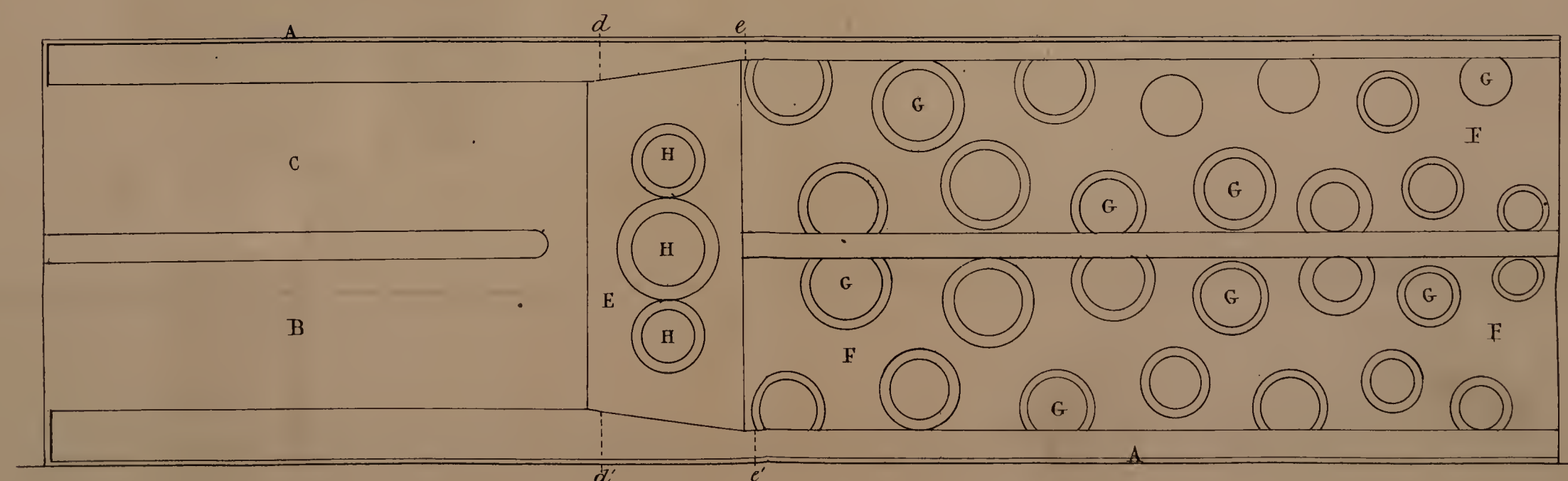
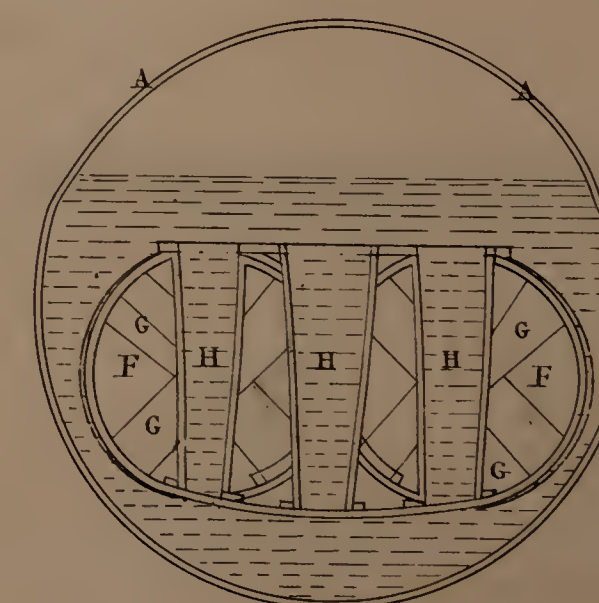


FIG. 13.



The enrolled drawing is partly colored.

FIG. 15.

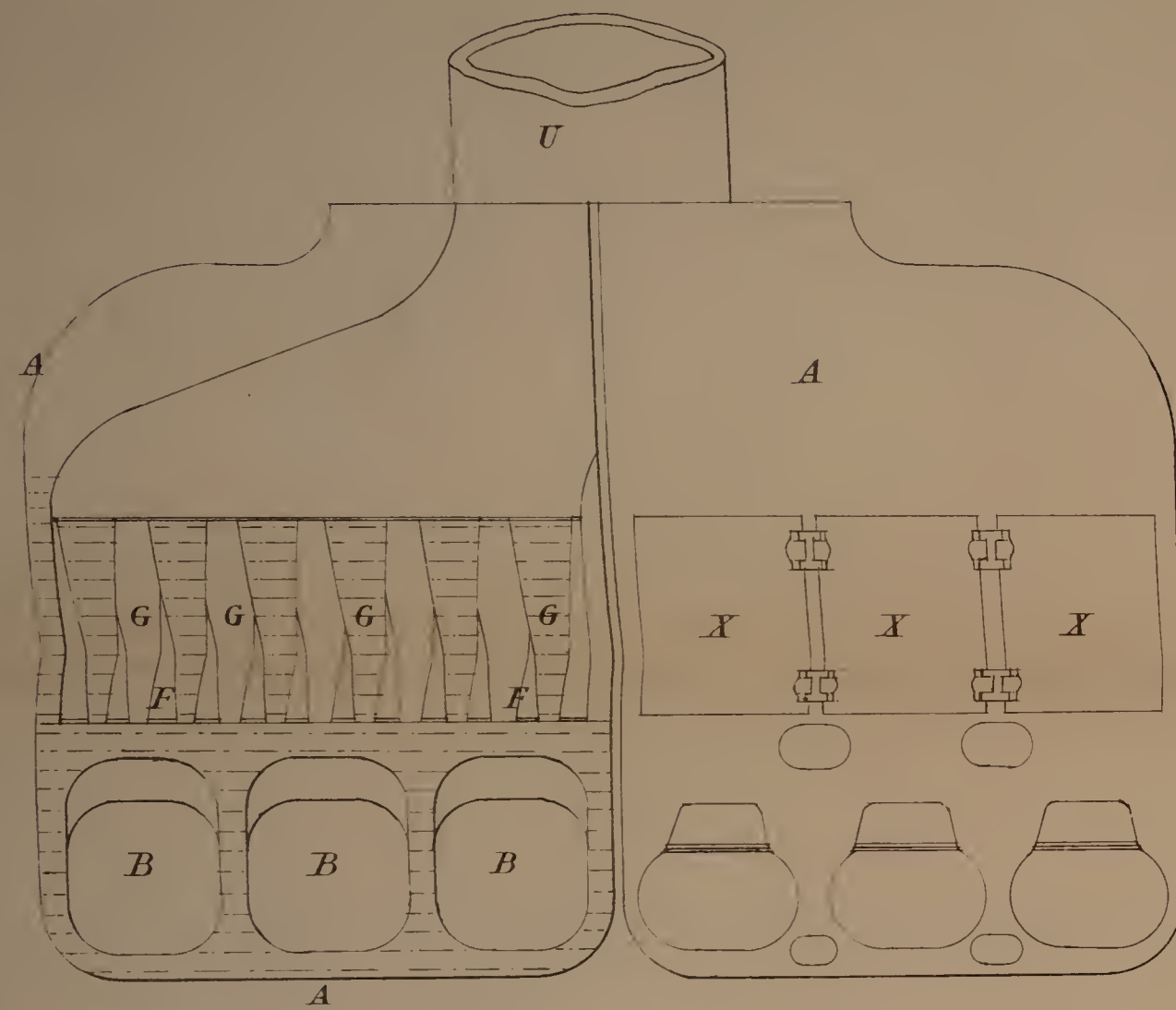


FIG. 17.

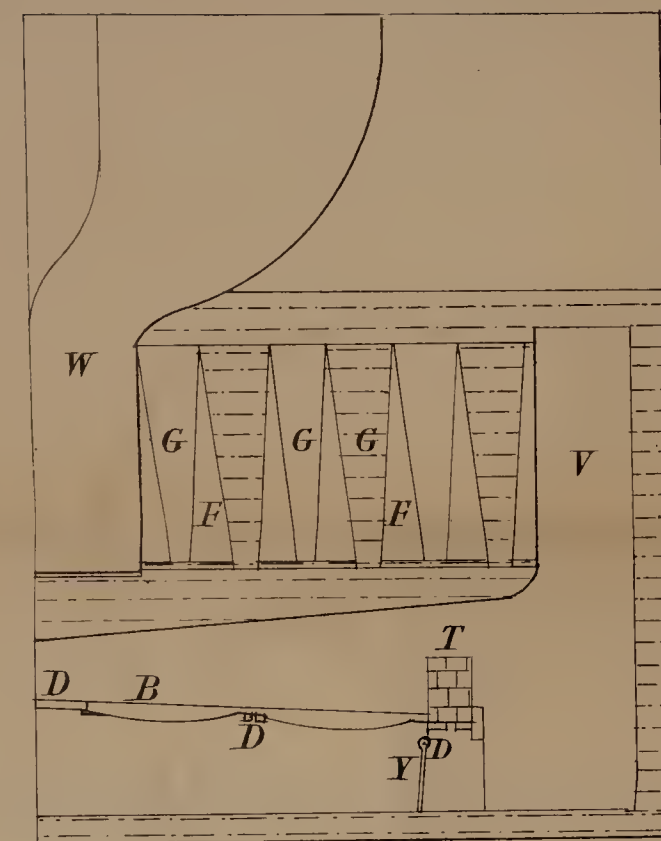


FIG. 19.

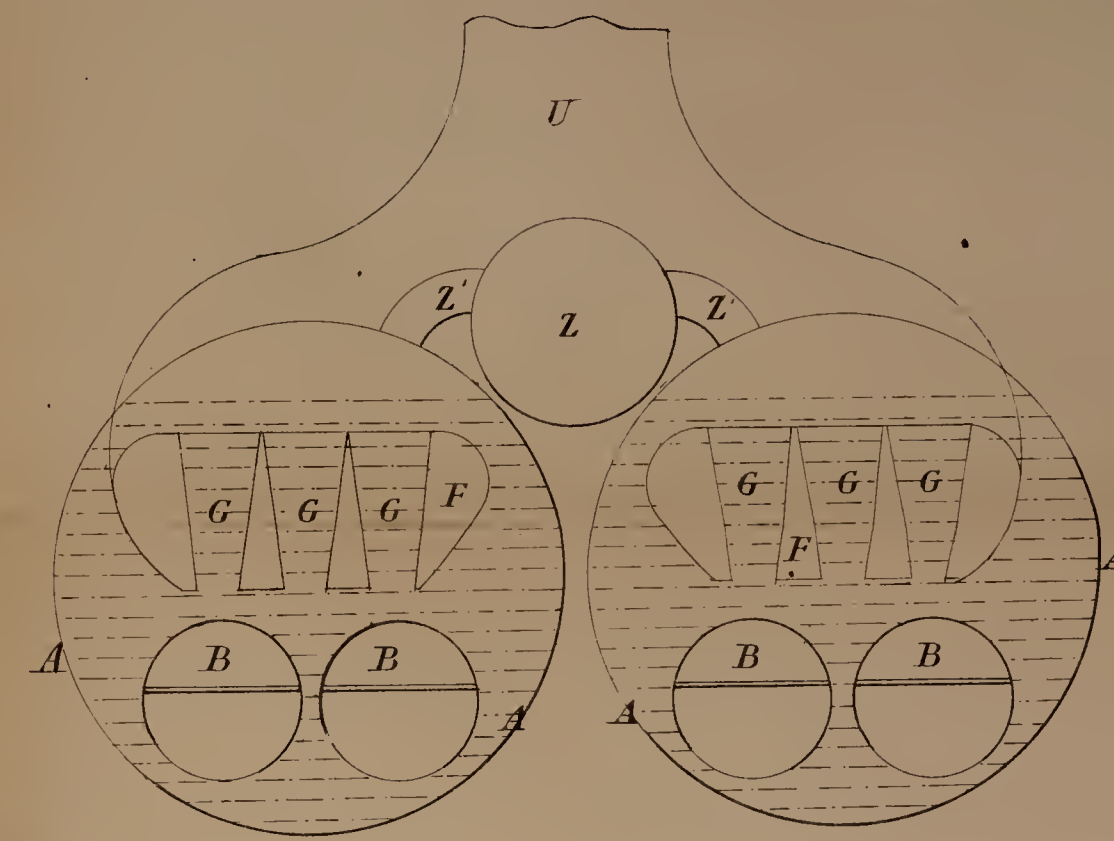


FIG. 20.

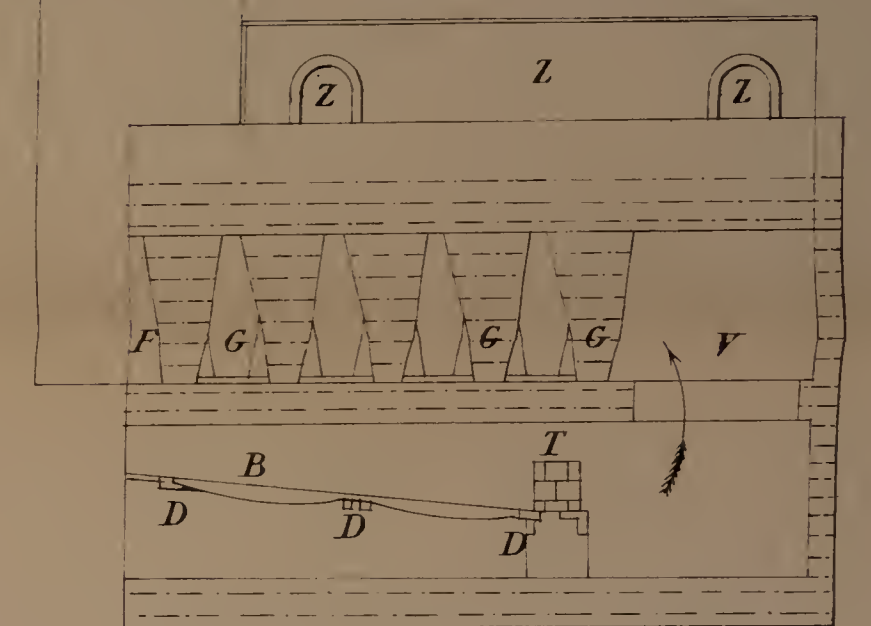


FIG. 16.

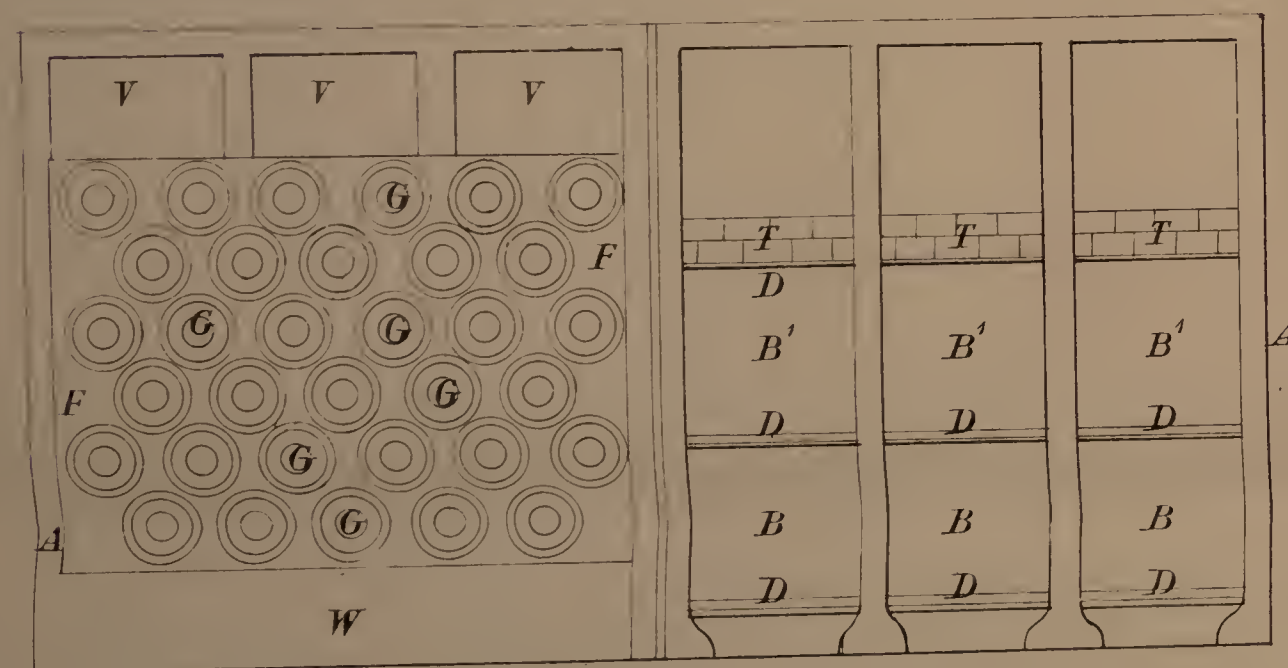
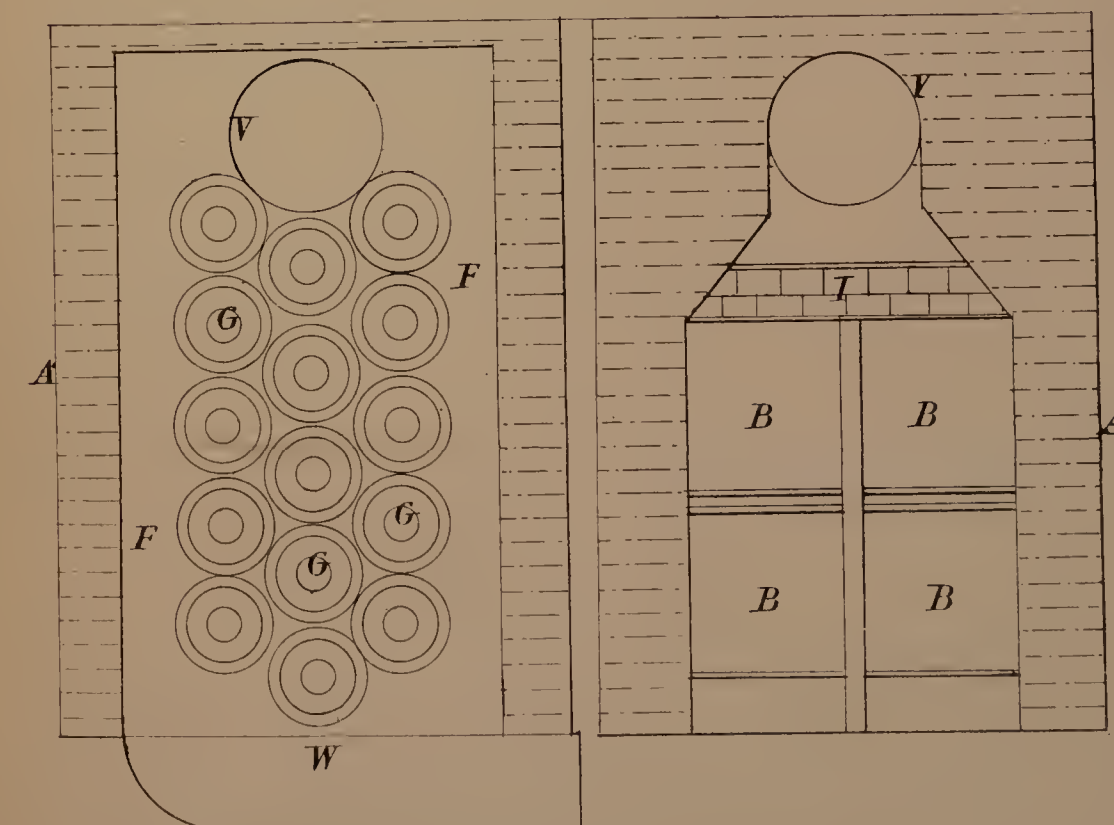


FIG. 19.



The enrolled drawing is partly altered.

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FIG. 24.

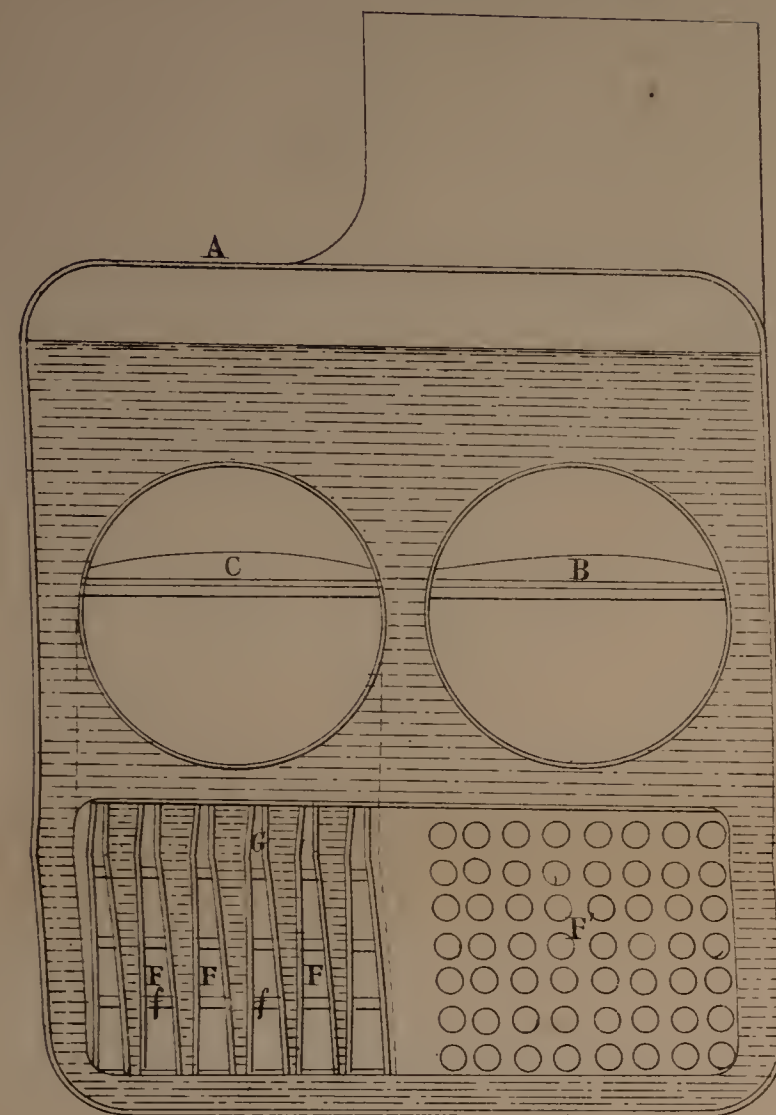


FIG. 25.

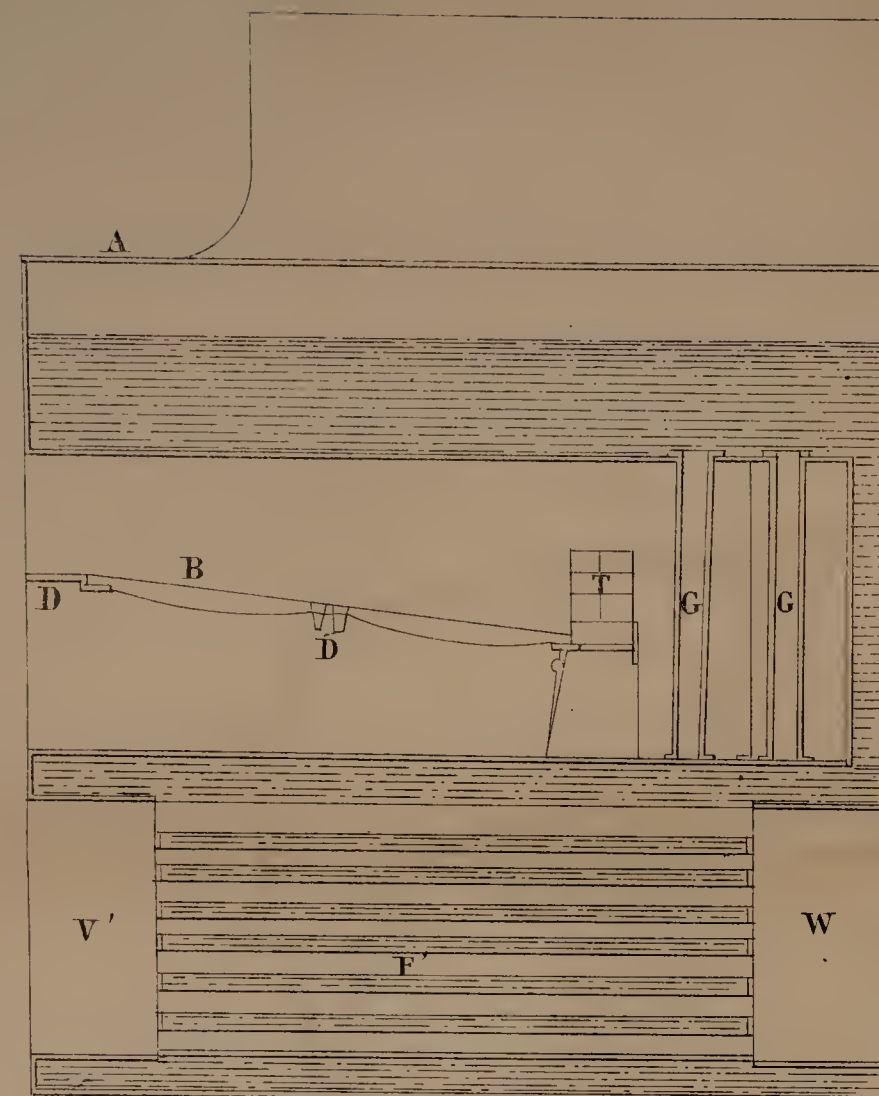


FIG. 21.

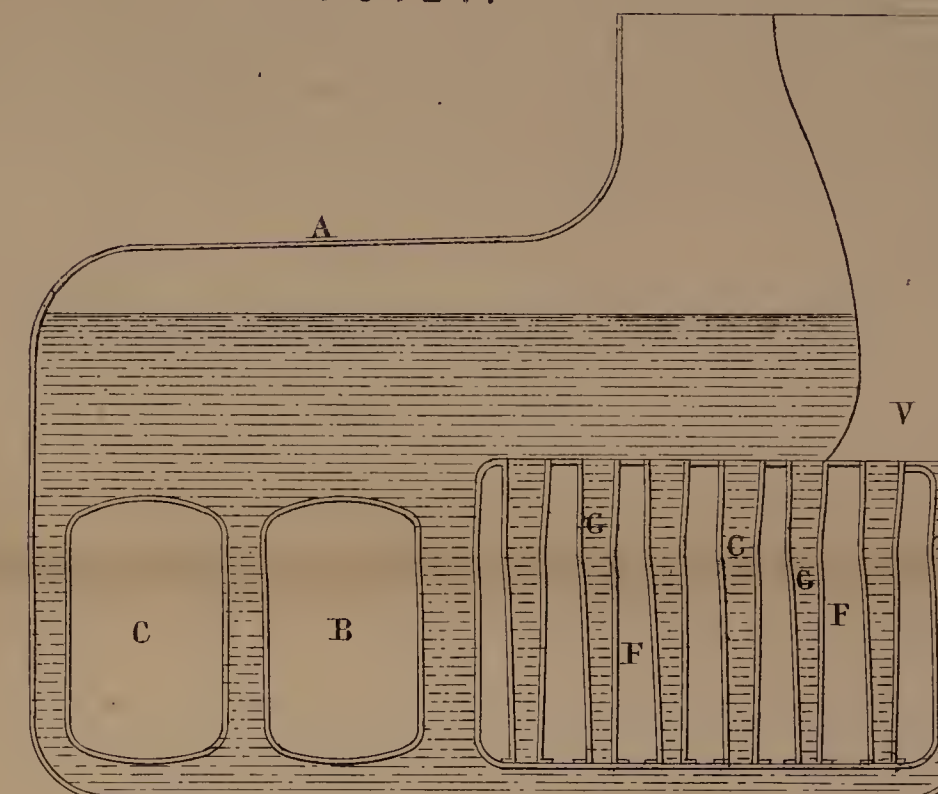


FIG. 22.

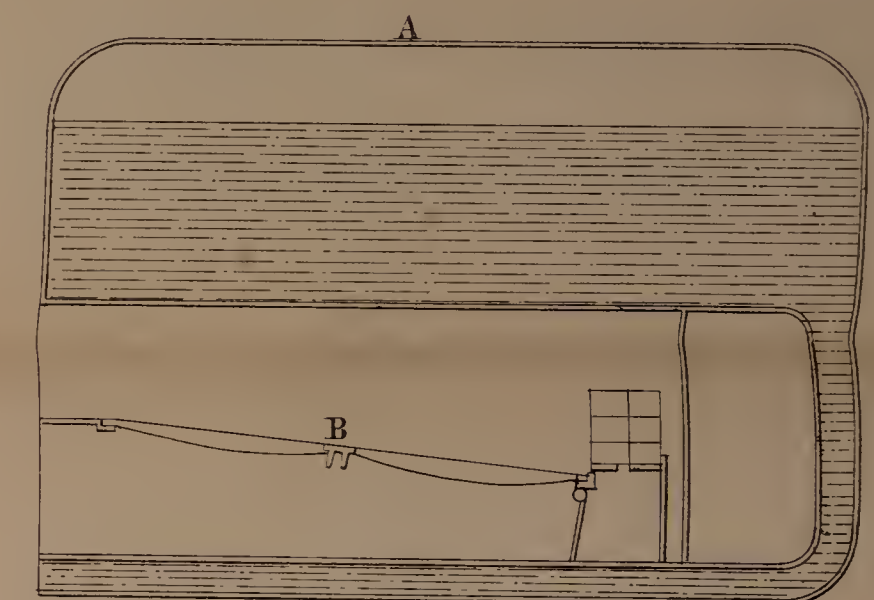


FIG. 26.

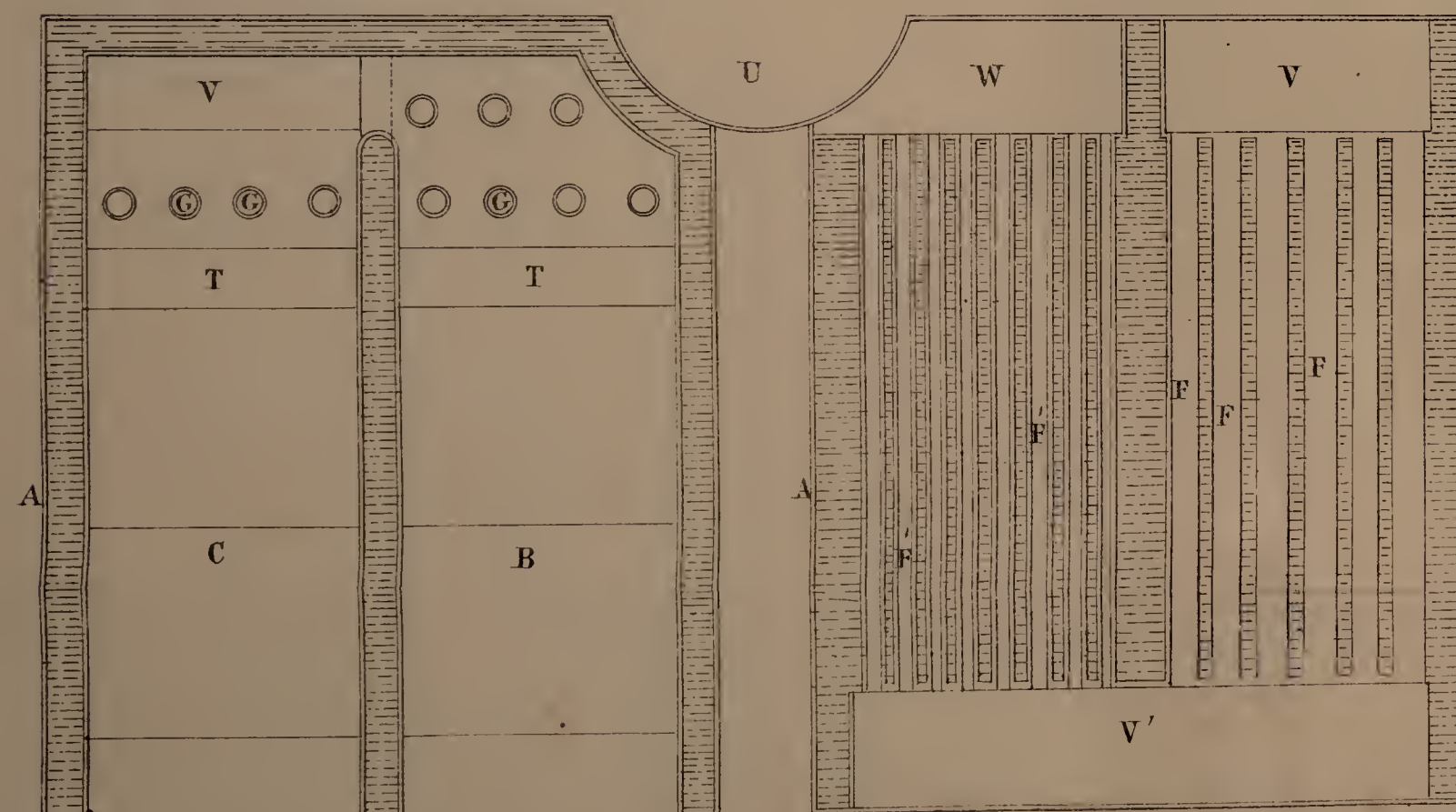
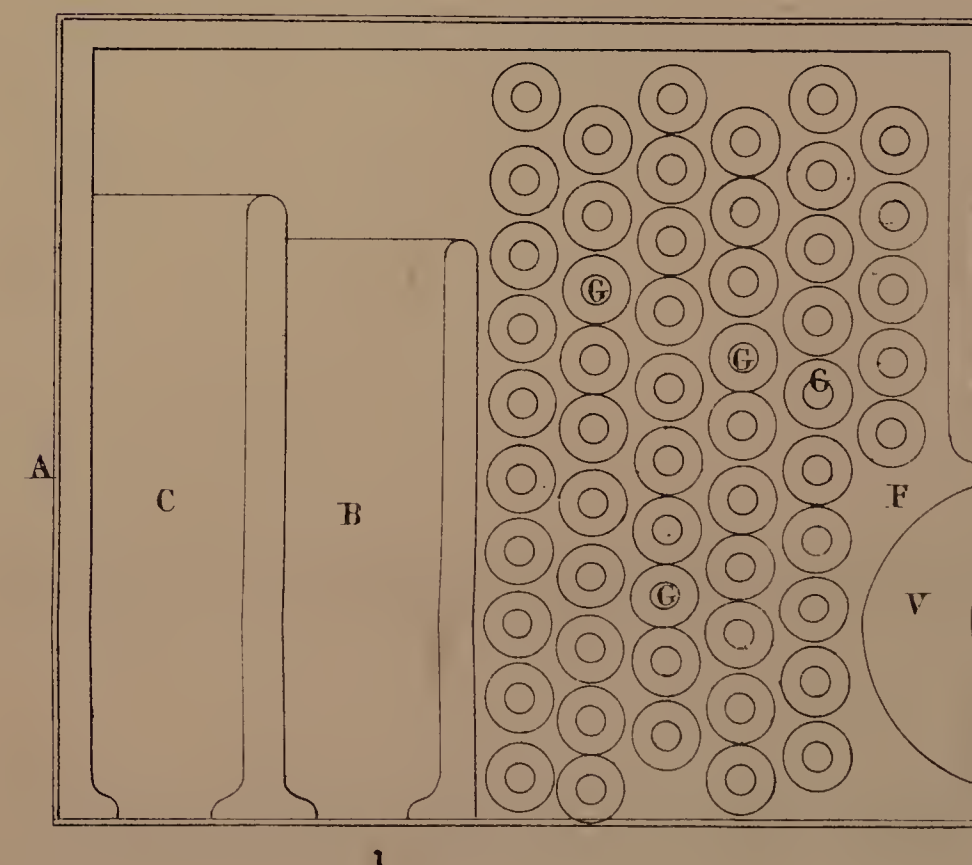


FIG. 23.



The enrolled drawing is partly colored

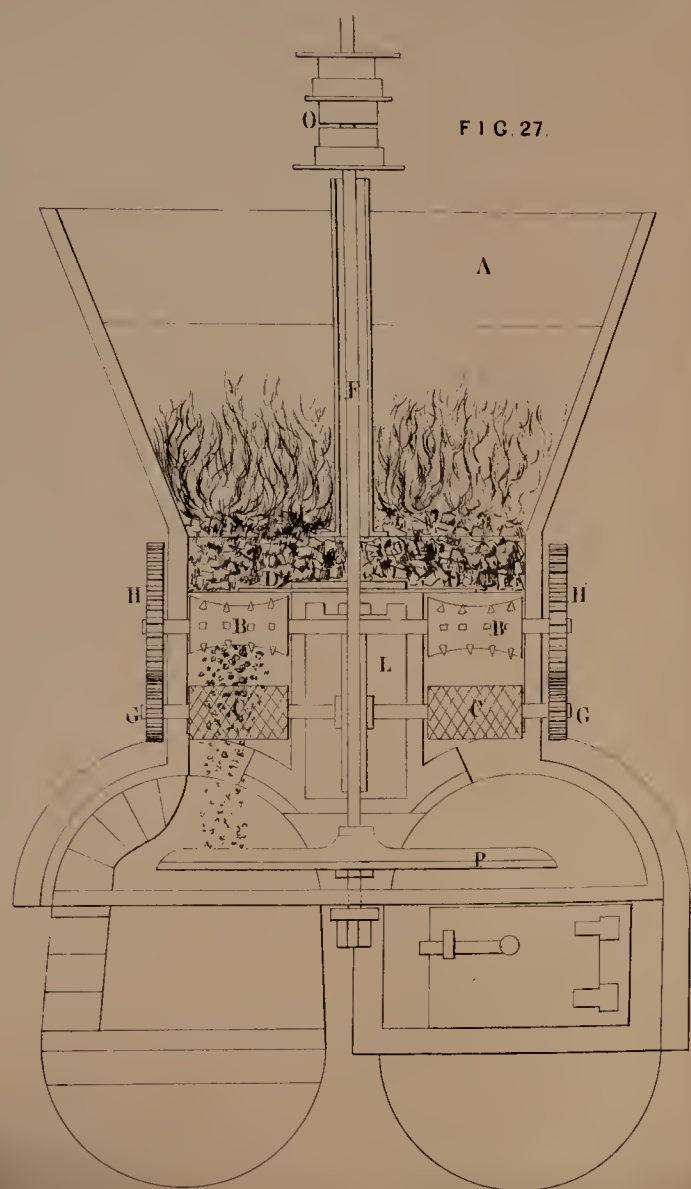


FIG. 27.

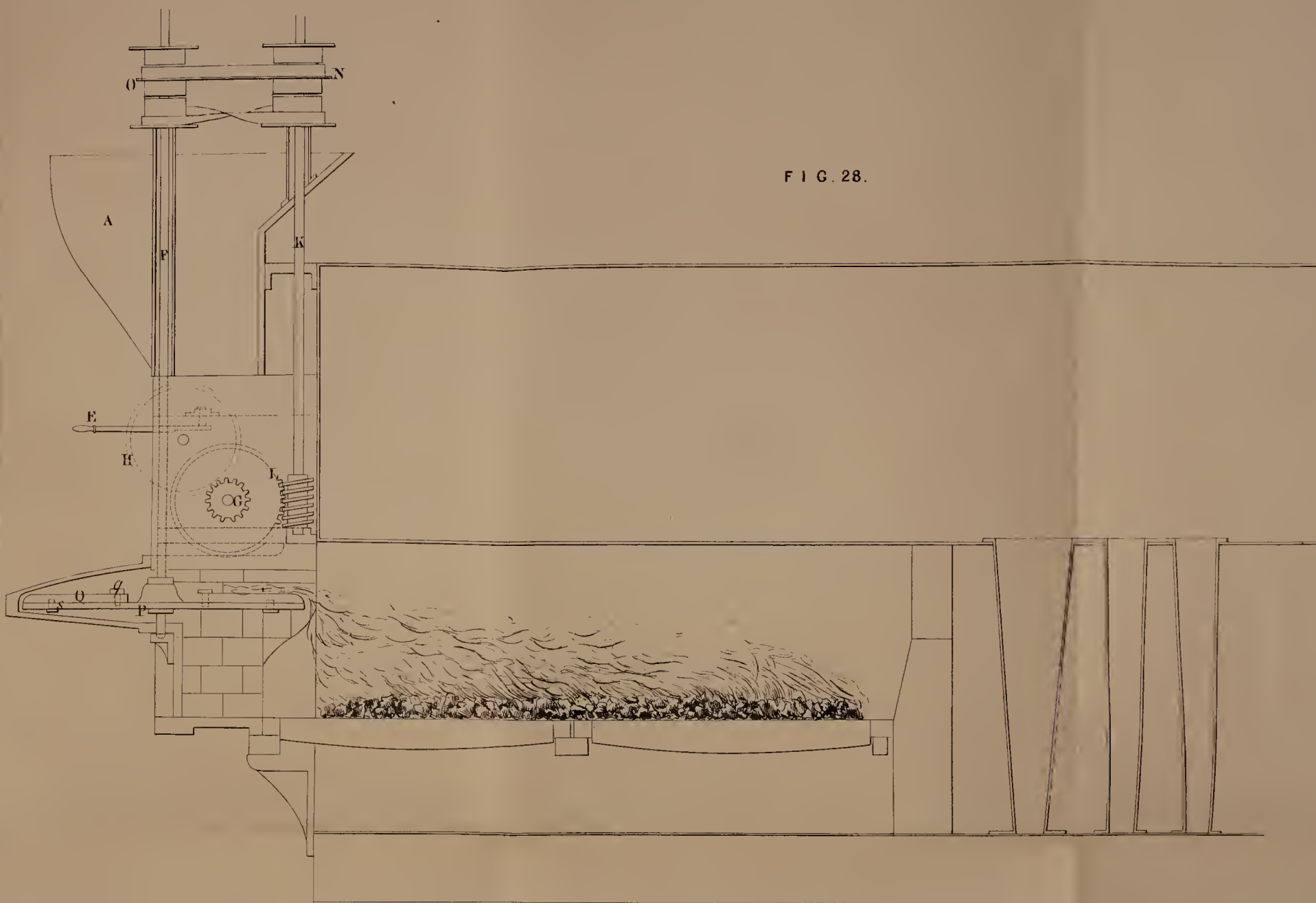


FIG. 28.

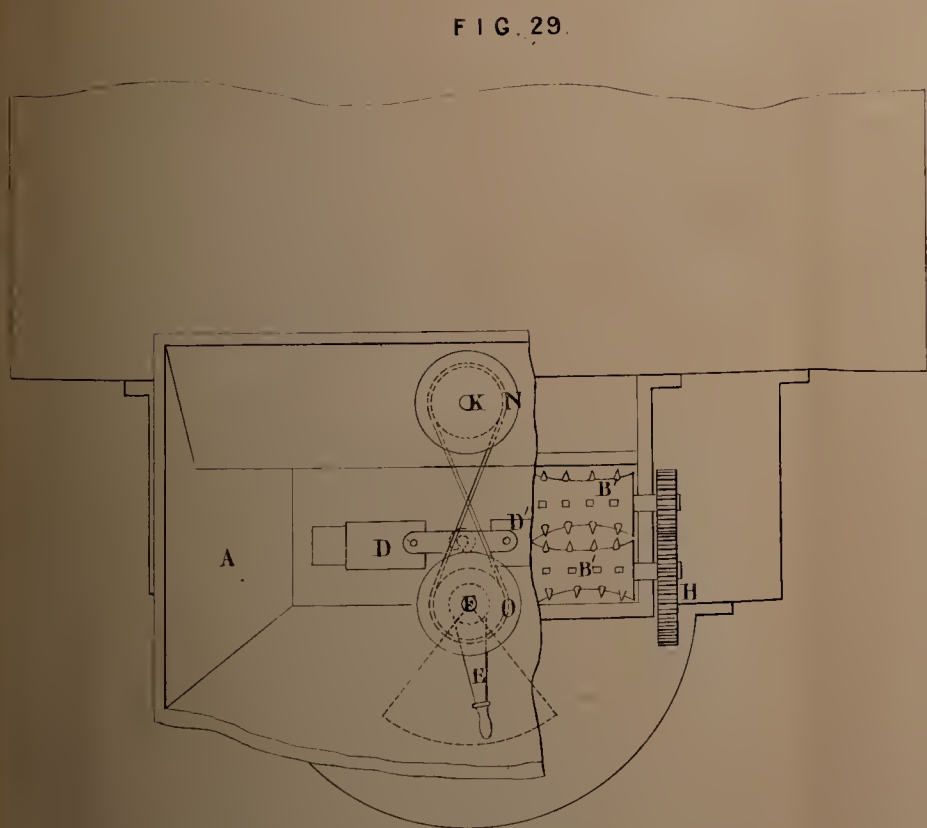


FIG. 29.

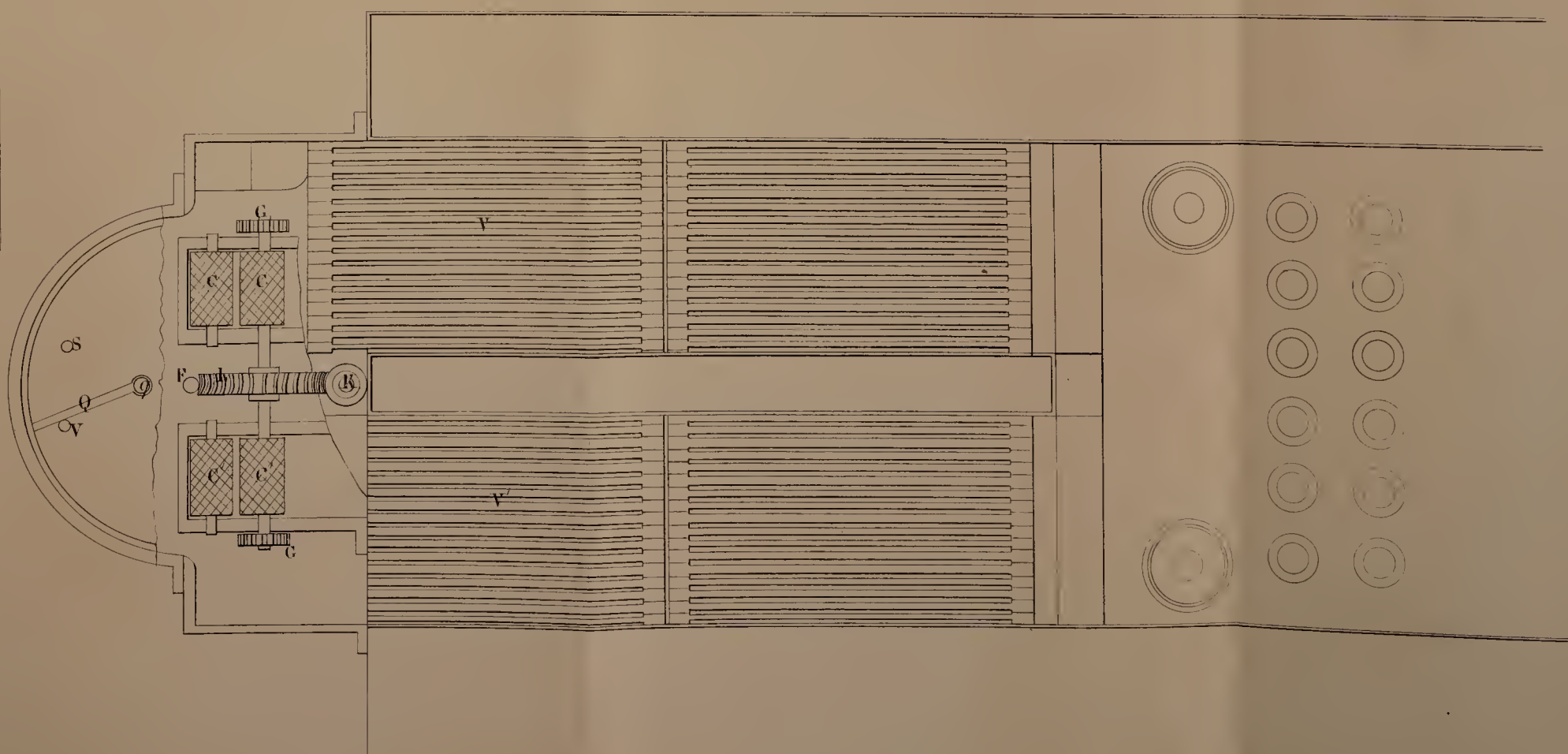


FIG. 30.

FIG. 31.

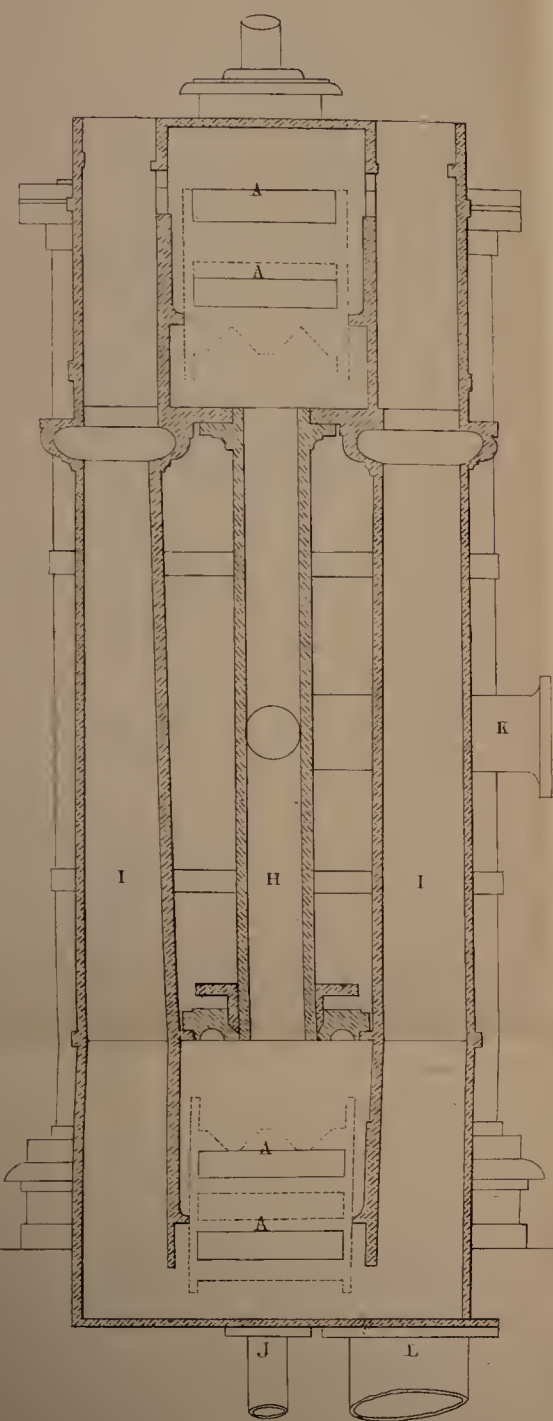


FIG. 32.

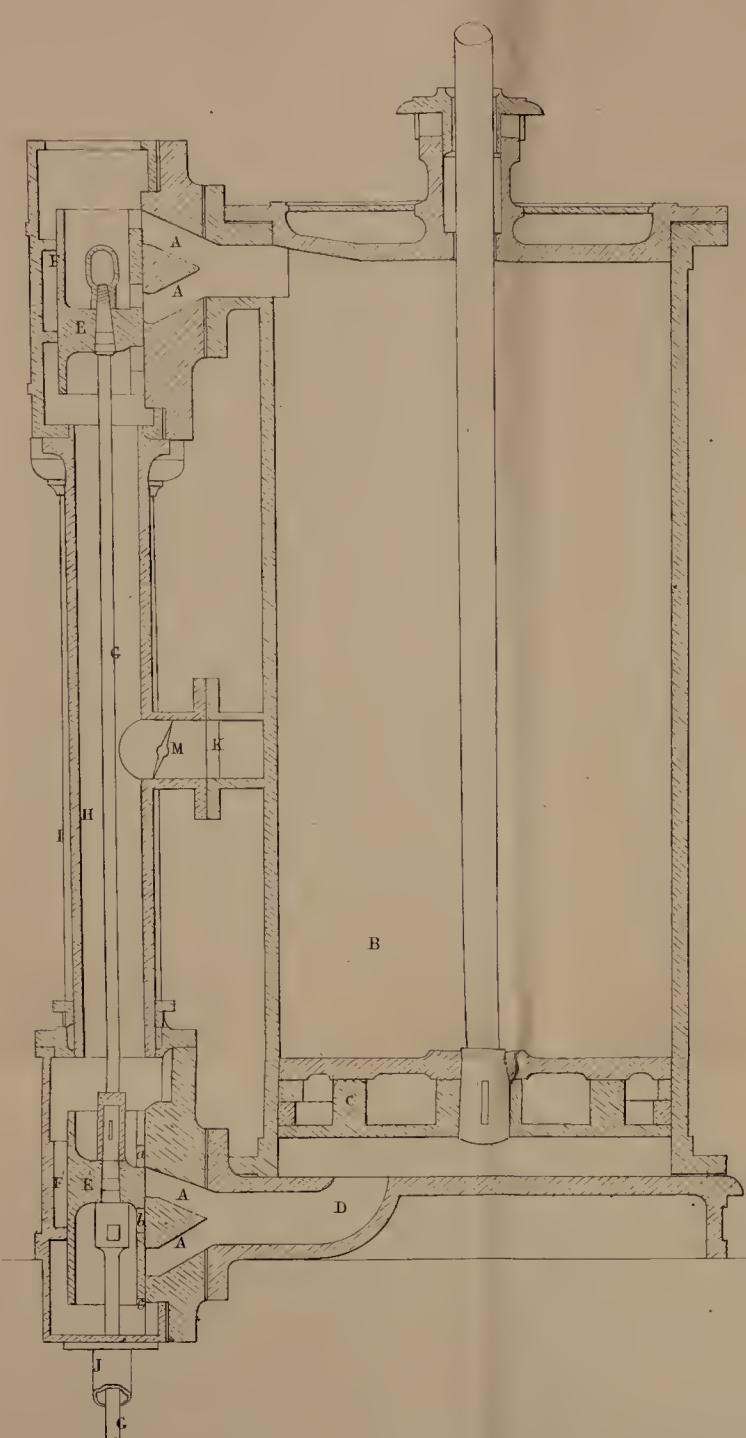


FIG. 35.

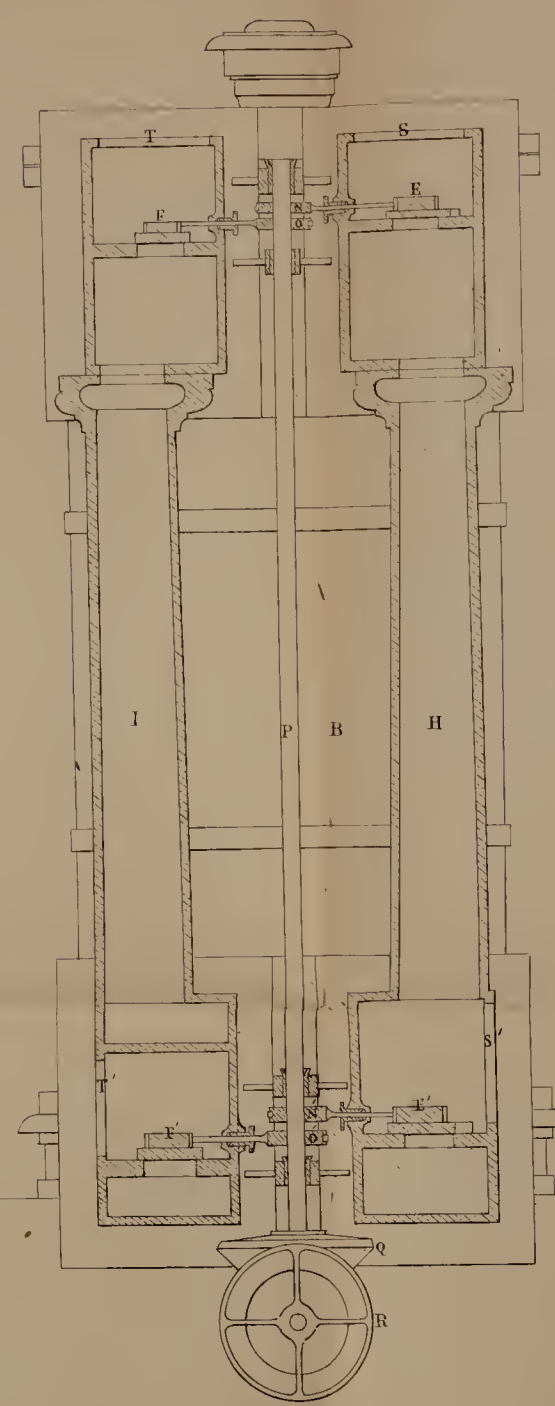


FIG. 36.

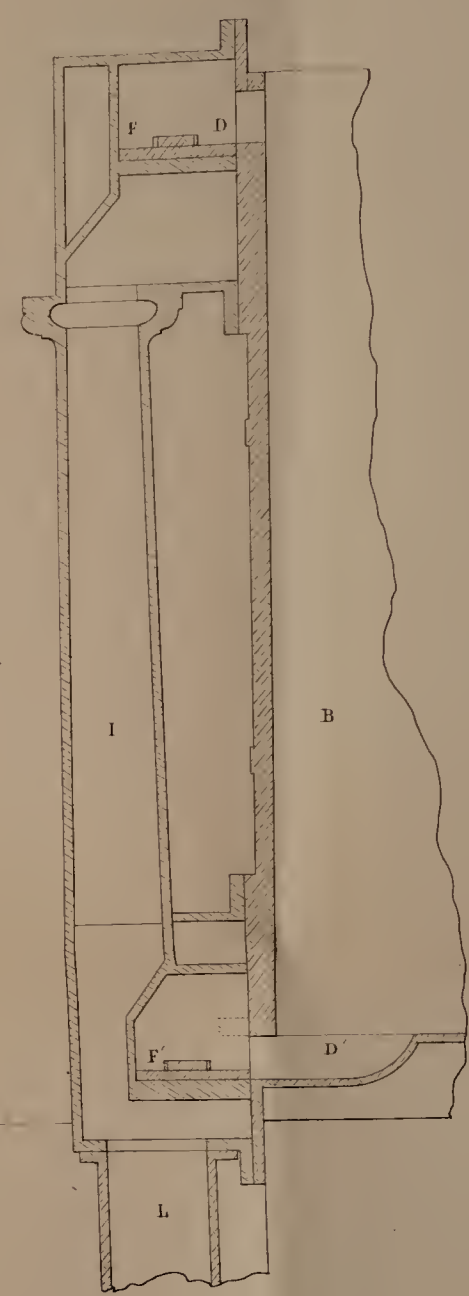


FIG. 37.

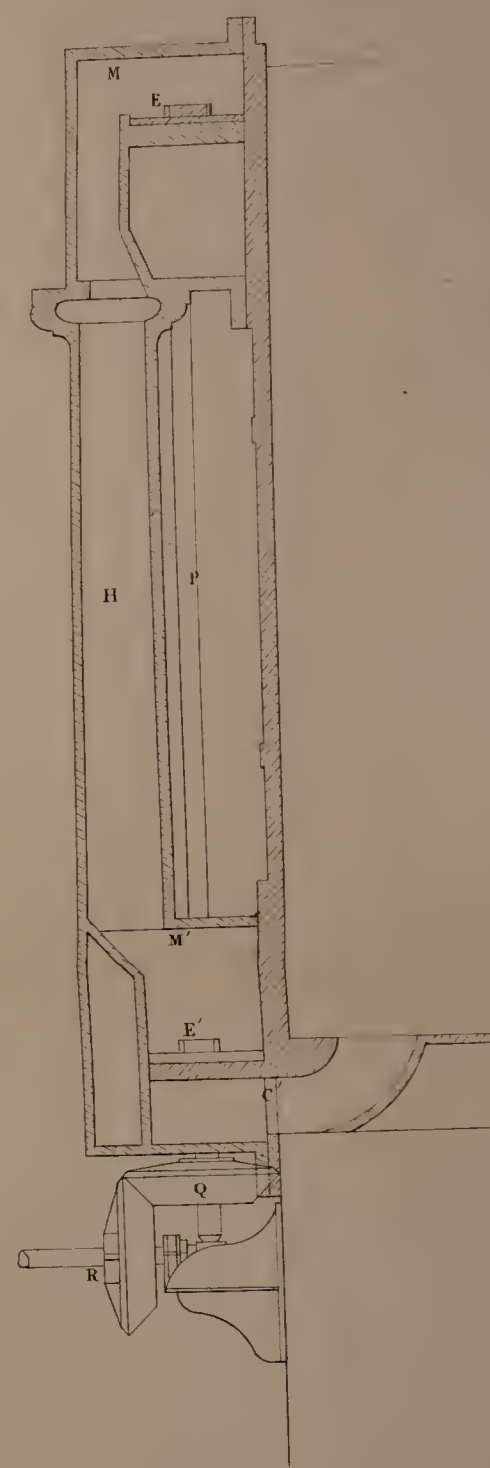


FIG. 33.

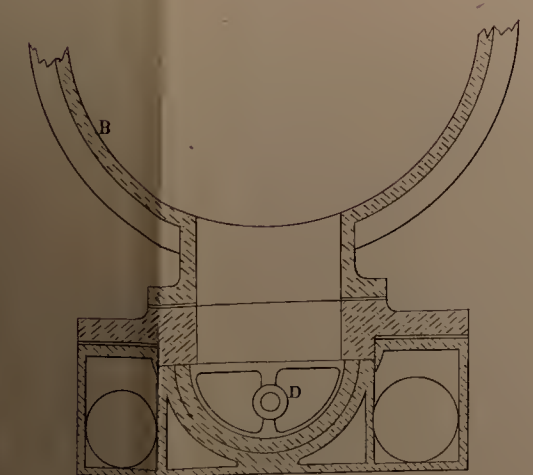


FIG. 34.

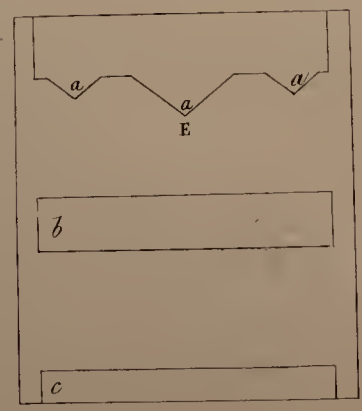


FIG. 38.

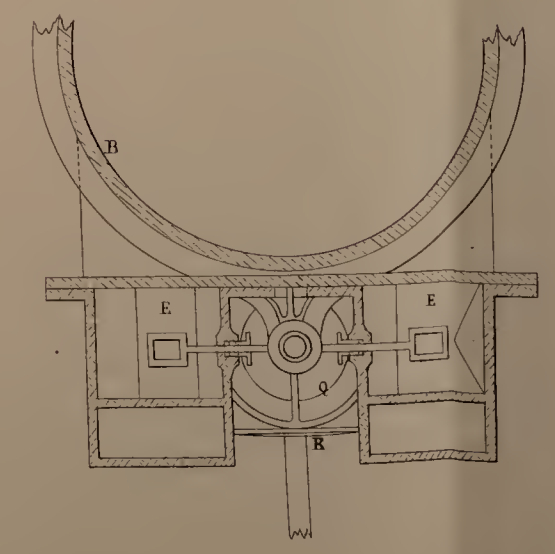


FIG. 1.
Section through C.C.

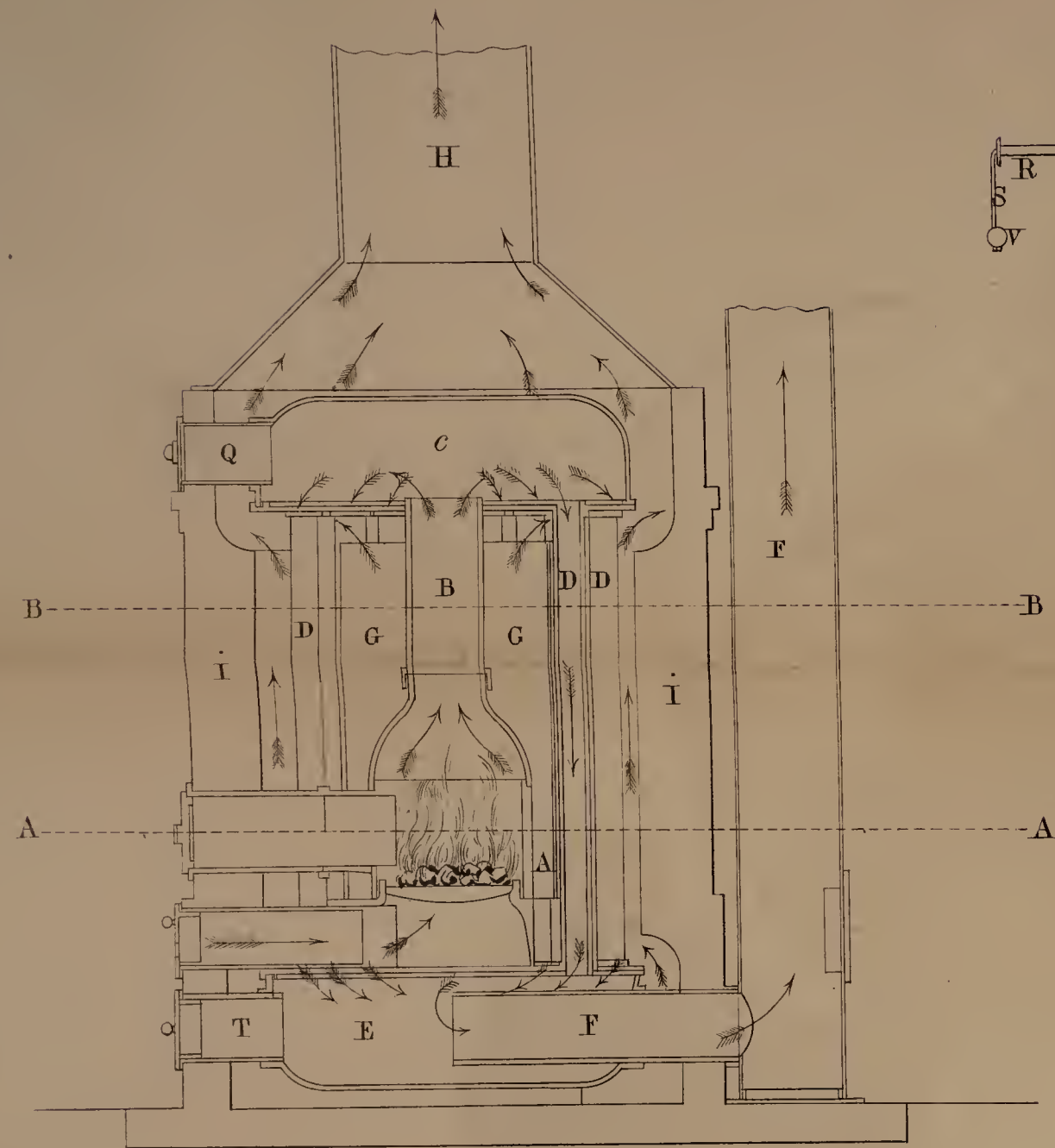


FIG. 5.

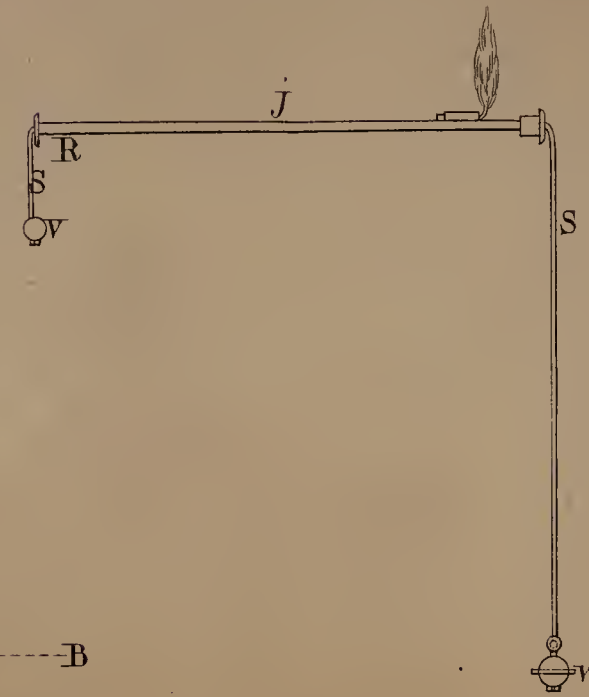


FIG. 4.
Side View.

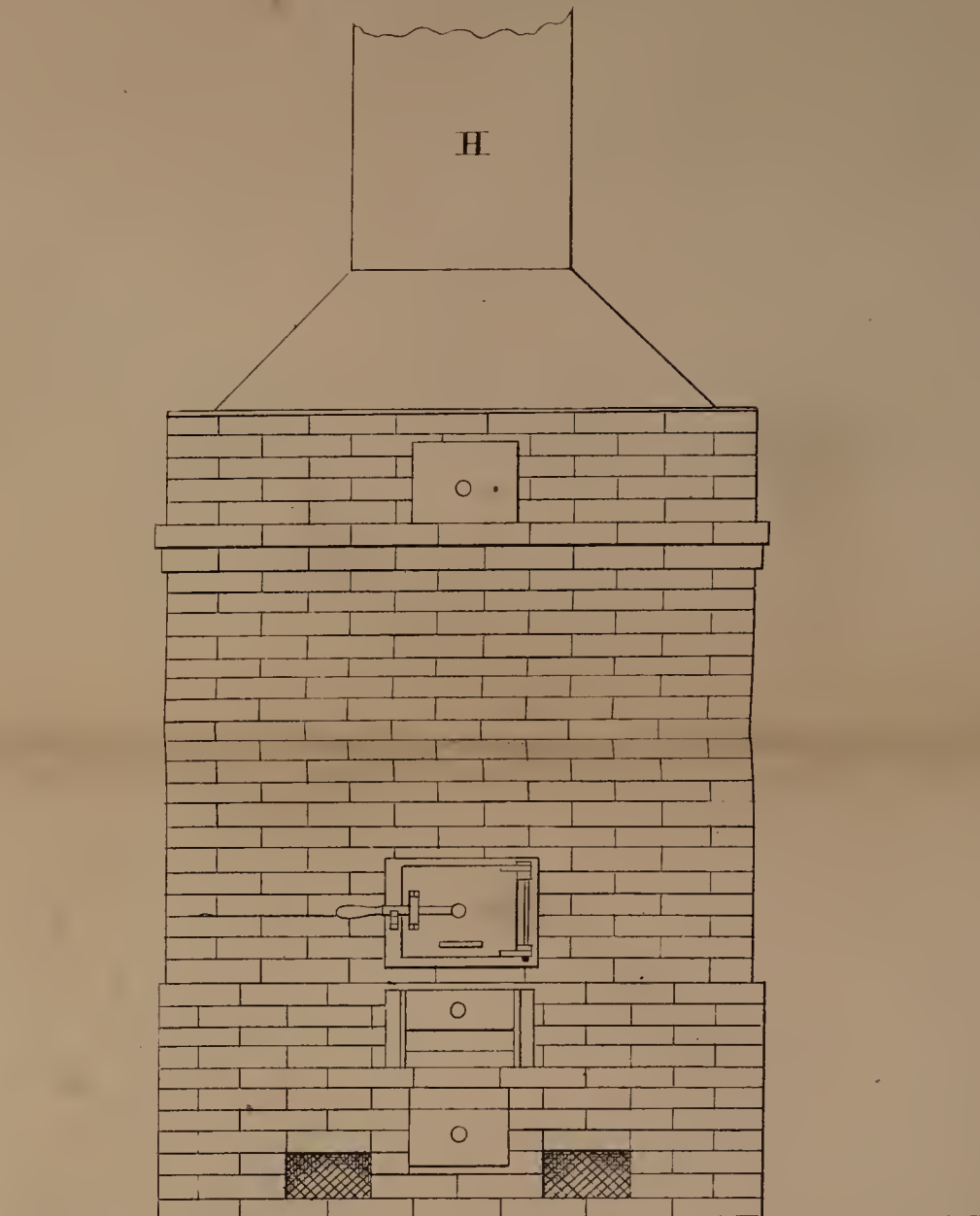


FIG. 2.
Section through A.A.

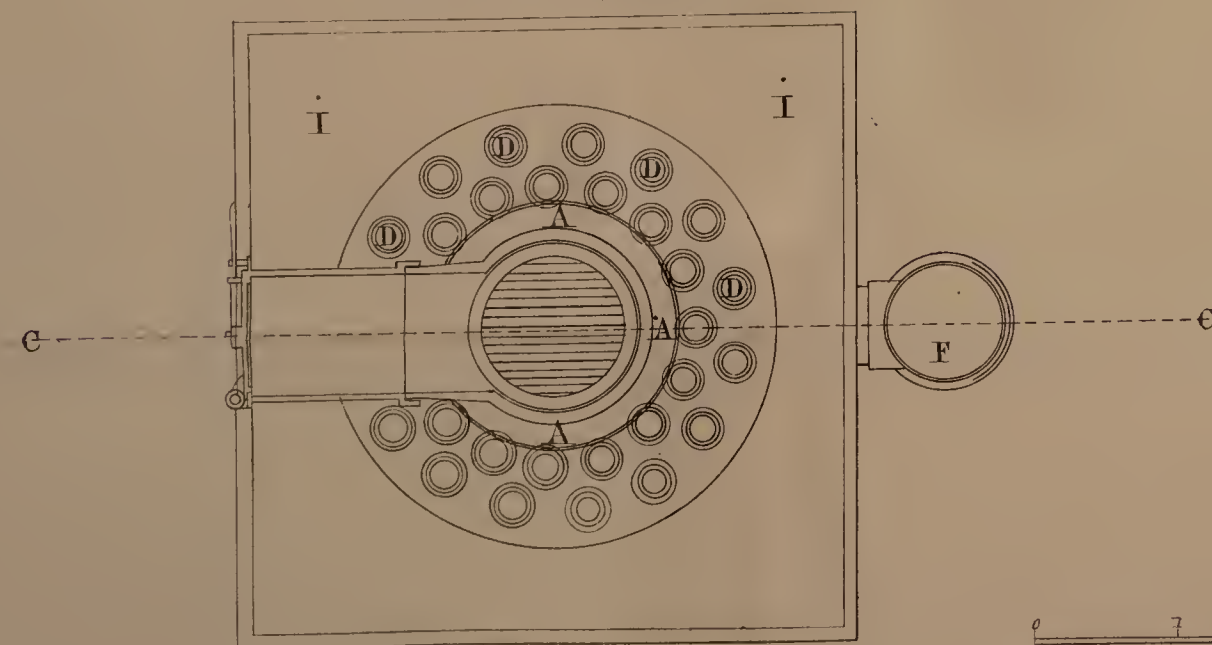
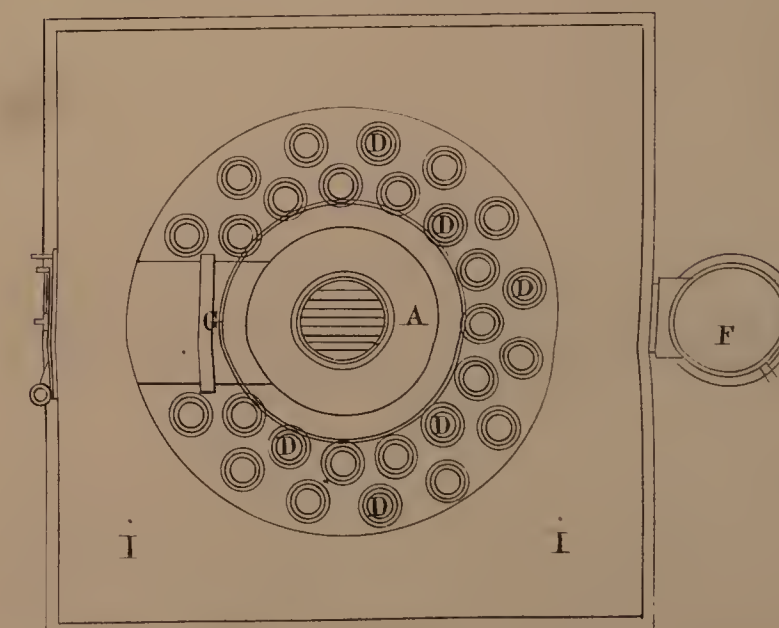


FIG. 3.
Section through B.B.



Scale.



The enrolled drawing is partly colored

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W. & J. Galloway's Improvements in Steam Engines and Boilers.

Ninthly, the constructing boilers with two furnaces, side by side, with a revolving fan between them, so arranged that by revolving in one direction it feeds one fire with fuel, and by revolving in the opposite direction it feeds the other fire, as herein-before described.

5 Tenthly, the application of a damper or dampers, folding up under the fire bars of boilers to regulate the admission of air, as herein-before described.

Eleventhly, the constructing boilers with an external sediment collector placed below the boiler, and so arranged that the water may circulate through it, the sediment collector being furnished with an agitator and a blow-off cock,
10 as herein-before described.

Twelfthly, the constructing the slide valves with a "vandyked" edge, or an edge furnished with two or more angular notches, for the purpose of admitting the steam gradually, as herein-before described.

Thirteenthly, the constructing the slide valves of steam engines, and the faces
15 whereon they work, with two or more passages for the escape of the waste steam, so as afford a large area of opening by a small motion of the valve, as herein-before described.

Fourteenthly, the constructing the slide valves of steam engines with a "vandyked" edge for the admission of steam, and double passages for the
20 escape of the steam in the same valve, as herein-before described.

Fifteenthly, the constructing steam engines with three parallel pipes or columns, of which the central one is the steam passage, and the external ones the exhaust passages, as herein-before described in reference to Figures 31, 32, and 33, Sheet 6.

25 Sixteenthly, the constructing steam engines with four slide valves, worked directly by four excentrics or cams on one shaft, as herein-before described.

Seventeenthly, the constructing steam engines with slide valves of a square, diamond, or angular form, and with angular seats to correspond, the same being applied without any slide box, and being furnished with a diaphragm or
30 division in the valve itself, to separate the steam and exhaust passages, as herein-before described.

Eighteenthly, the constructing steam engines with a throttle valve between the cylinder and the slide or other valve, by which the engine is worked, so as to be capable of arresting either the entrance or exit of the steam, or both.

35 In witness whereof, I, the said William Galloway, have hereunto set my hand and seal, this Eleventh day of September, in the year of our Lord One thousand eight hundred and fifty-one.

WILLIAM (L.S.) GALLOWAY.

W. & J. Galloway's Improvements in Steam Engines and Boilers.

WARD.

AND BE IT REMEMBERED, that on the Eleventh day of September, in the year of our Lord 1851, the aforesaid William Galloway came before our said Lady the Queen in Her Chancery, and acknowledged the Specification aforesaid, and all and everything therein contained and specified, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose.

Enrolled the Eleventh day of September, in the year of our Lord One thousand eight hundred and fifty-one.

LONDON :

Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1854.